2009 年复旦物理系学术年会

报告摘要集

复旦大学物理系

2009 年 5 月 15 日

内容

会议简介

会议时间

5 月 16 日-17 日（周六、周日两天）

参加对象

物理系硕、博研究生、教师。

会议目的

以学术促交流，以交流促学术。

学术委员会

召集人：金晓峰

委员：蒋最敏 封东来 龚新高 侯晓远 陆昉 陶瑞宝 王斌 吴长勤 游建强 资剑 周仕明 周鲁卫 张新夷 王迅 周磊

年会筹备委员会

召集人：周磊

委员：陈骏逸、蔡越华、刘凡美、刘范美、高太梅、丁桂兰、魏心源、宋雷娟、周磊课题组学生

年会召开期间的全体工作人员

蔡越华、刘凡美、史玲玲、刁慧萍、刘范美、陈骏逸、宋雷娟、周磊老师课题组学生

会议计划

邀请报告　5 个， 30 分钟/个

口头报告　11 个，15 分钟/个

海报　140 个

2009 年复旦物理系学术年会日程安排

Saturday, 17 May 2009　(地点：美研中心)

8:00-8:50	注册（登记并领取餐票）	
8:50-9:00	开幕式（发言人：金晓峰）	
邀请报告	(主席: 陶瑞宝)	
9:00-9:30	黄吉平	The "Invisible Hand" in Resource Allocation: Human Experiments and Agent-Based Simulations
口头报告 + 教学特别报告	(主席: 施郁)	
9:30 – 9:45	张新夷	Do acupuncture points exist?
9:45 - 10:00	乐永康	**“物理实验基础”课教学心得**
10:00 -10:15	殷亘 (陈灏课题组)	Transport properties of graphene nanoribbon junctions: an ab initio point of view
10: 15-12:00	**茶歇 / 海报（第一场）**	
12: 15	拍集体照（拍照地点：光华楼正门）	
12:30-14:00	**午餐 （教授餐厅）**	
邀请报告	(主席: 苏汝铿)	
14:00-14:30	林志方	**“戏说物理须常乐”之：阴阳反射**
口头报告	(主席: 孙鑫)	
14:30-14:45	李重要 (杨中芹课题组)	Magnetic structures and spin filtering effect in pure and nitrogen-doped carbon atomic wires
14:45-15:00	尹万健 (龚新高课题组)	Unusual band-gap and band-edge bowing of SnGe alloy
15:00-15:15	姚尧 (吴长勤课题组)	A theoretical model on organic magnetic field effect
15:15-17:00	**茶歇 / 海报（第二场）**	

Sunday, 18 May 2009 (地点：美研中心)

邀请报告		(主席: 陈张海)
8:45-9:15	资剑	Flat metallic surfaces coated with periodically textured dielectric layers: a promising plasmonic system
9:15-9:45	金晓峰	Proper Scaling of the Anomalous Hall Effect
口头报告		(主席: 韦广红)
9:45-10:00	欧宏炜 (封东来课题组)	氧化物界面的新奇物理性质
10:00-10:15	周伟航 (陈张海课题组)	Anisotropic diamagnetic Kepler Problem in solid state environment
10:15-12:00	**茶歇 / 海报（第三场）**	
12:00-14:00	**午餐 （美研中心，快餐）**	
邀请报告		(主席: 杨新菊)
14:00-14:30	周磊	Optical and plasmonic metamaterials
口头报告		(主席: 杨中芹)
14:30-14:45	韩春蕊 (周鲁卫题组)	Study in Self-assembly and Structure Properties of Colloidal Crystal
14:45-15:00	孙晓宇 (侯晓远课题组)	Dissociation of excitons in the C60 film studied by transient photovoltage measurements
15:00-15:15	丁金亮 (钱士雄课题组)	Nonlinear optical properties and ultrafast dynamics of undoped and doped bulk SiC
15:15-15:20	闭幕式（发言人：金晓峰）	
15:20-17:00	**茶歇 / 海报（第四场）**	

会议目录

Oral talk

Poster session

报告摘要

The "Invisible Hand" in Resource Allocation: Human Experiments and Agent-Based Simulations

黄吉平

Do acupuncture points exist?

Xinyi Zhang[1,2], Xiaohui Yan[1,2], Chenglin Liu[1,3], Yuan Zhang[1], Dongming Zhang[1], Junyao Huang[1], Guanghong Ding[2], Yuying Huang[4], Wei He[4], Peiping Zhu[4], Shiqiang Wei[5], Zhiyun Pan[5], Ruishan Dang[6], Masami Ando[7], Hiroshi Sugiyama[8], Hiroyuki Oyanagi[9], Huansheng Chen[10]

1 Physics Department, Surface Physics Laboratory (State Key Laboratory), and Synchrotron Radiation Research Center of Fudan University, Shanghai

2 Shanghai Research center of Acupuncture and Meridian, Shanghai

3 Physics Department of Yancheng Teachers' College, Yancheng

4 Beijing Synchrotron Radiation Facility, Beijing

5 National Synchrotron Radiation Laboratory, Hefei

6 Second Military Medical University, Shanghai

7 DDS center, Research Institute for Science and Technology, Tokyo University of Science, Yamasaki 2541, Noda, Chiba 278-8510, Japan

8 Photon Factory, Institute of Material Structure Science, High Energy Accelerator Research Organization, Oho 1-1,Tsukuba, Ibaraki 305-0801, Japan

9 National Institute of Advanced Industrial Science and Technology, Japan

10 Institute of Modern Physics, Fudan University, Shanghai

Abstract

There are specific acupuncture points on the surface of the human body. Although these points can be used to monitor the health of an individual and restore the health through stimulation of these points, the existence of these special points is always oppugned. In this work, three different synchrotron-based methods were used to study the characteristics of acupuncture points in order to prove their existence.

First, the topographic structures of acupuncture points were investigated by using the phase contrast imaging. Seven acupuncture points were studied: Waiqiu, Sanyinjiao, Neiguan, Guanyuan, Zusanli, Tianshu and Shangjuxu. We have found that at least at five acupuncture points (Waiqiu, Sanyinjiao, Neiguan, Tianshu and Zusanli) there exists the accumulation of microvessels. The images taken in the surrounding tissue out of the acupuncture points do not show such kind of structure.

Secondly, we used synchrotron x-ray fluorescence analysis to probe the distribution of four chemical elements in and around acupuncture points, two located in the forearm and two in the lower leg. Three of the four acupuncture points showed significantly elevated concentrations of elements Ca, Fe, Cu and Zn in relation to levels in the surrounding tissue, with similar elevation ratios for Cu and Fe. The mapped distribution of these elements implies that each acupuncture point seems to be elliptical with the long axis along the meridian.

Thirdly, using the X-ray absorption fine structure (XAFS) to study the local structures of Zn and Fe in acupuncture points, we find that the coordinate situations are different in or out of the acupuncture points.

基础物理实验教学心得

物理教学实验中心　乐永康

物理实验课的基本目的[1]：1）让学生在物理实验的基本知识、基本知识、基本技能方面得到严格而系统的训练（三基训练）；2）让学生实践用实验方法研究物理现象、验证物理规律，加深对物理理论的理解和掌握，并在实践中提高发现问题、分析问题和解决问题的能力；3）培养学生实事求是的科学态度和积极创新的科学精神。要达成以上教学目标，学生、教学内容、老师指导三者要成为一个有机的整体。

我们将结合物理实验课程中的几个教学案例，特别是在引导学生“用实验方法研究物理现象、验证物理规律，加深对物理理论的理解和掌握，并在实践中提高发现问题、分析问题和解决问题的能力”的尝试，谈谈对实验教学过程中教师如何更好地发挥作用的一些理解。

参考文献：

[1] 《基础物理实验》沈元华 陆申龙 高等教育出版社 2003 年 12 月

Transport properties of graphene nanoribbon junctions: an ab initio point of view

殷亘

Gen Yin, Yunye Liang, Feng Jiang, Hao Chen

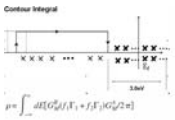
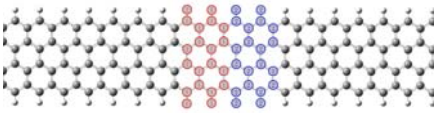
Physics Department, Fudan University, Shanghai 200433, P. R. China

Abstract:

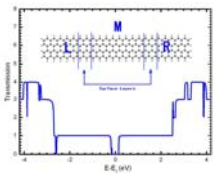
With the stunning development of electronic technology, traditional Silicon based devices has already encountered the scale limitation. Molecular electronic device is a qualified option for future development, and has already aroused worldwide attention both in academic and industrial fields [1] [2]. Graphene, with ultra high carrier mobility and thermal stability, is considered to be a probable basic material for future devices [3]. Combining the well developed nonequilibrium green's function method (NEGF) with DFT package of chemical software GAMESS(US), it is practical and applicable to examine transport properties of graphene based devices, investigate graphene-organic molecule combined junctions, and evaluate the possibility to apply graphene nanoribbons as integrated circuit connections. NEGF-DFT is a convenient method to design and predict various functional graphene based electronic devices such as transistors, switches, and highly efficient storage units [2] [4] [5]. In this talk, a detailed first principle calculation implement will be presented, and its validity will be demonstrated with a calculated transmission function of a zigzag edged pure graphene nanoribbon, matching with the band structure calculated with both tight bonding approximation (TB) and periodical boundary condition (PBC). Transport properties of organic molecule junctions contacted with semi-infinite graphene nanoribbons will also be investigated. External electric field effect of graphene nanoribbon edge defects will be presented in the end.

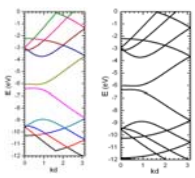
Outlines:

1, Modeling and algorithms (contour integral, surface green's function self-consist calculation, and landauer-Buttiker formalism)

2, Cluster based band structure calculation under tight bonding approximation

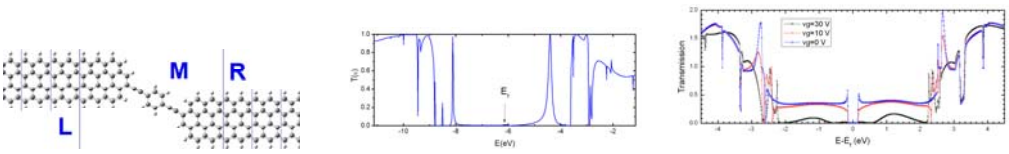




Left: PBC band structure with a cell contains two armchair carbon layers (Gaussian03)
Right: Band structur calculated from tight bonding approximation (Gamess-US)

3, Transmission function of zigzag edged graphene nanoribbon

4, Organic molecule junctions



5, Electrostatic field effect of edge defects

References:

[1] Xiaolin Li, Xinran Wang, Li Zhang, Sangwon Lee, Hongjie Dai, Science vol. 319 29 Feb, 2008

[2] Qimin Yan, Bing Huang, Jie Yu, Fawei Zheng, Ji Zang, Jian Wu, Bing-Lin Gu, Feng Liu, and Wenhui Duan Nano Lett., 2007, 7 (6), 1469

[3] Novoselov, K.S. et al. Science 306, 666 (2004)

[4] Luis A. Agapito* and Hai-Ping Cheng J. Phys. Chem. C 2007, 111, 14266-14273

[5] Lemme, M. C. et a. IEEE Electron Device Letters 28, 282 (2007)

“戏说物理须常乐”之：阴阳反射

林志方

Magnetic structures and spin filtering effect in pure and nitrogen-doped carbon atomic wires

李重要

Z. Y. Li[1], W. Sheng[1], Z. Y. Ning[2], Z. H. Zhang[3], Z. Q. Yang[1], and H. Guo[2]

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[2]Center for the Physics of Materials and Department of Physics, McGill University, Montreal, Quebec, Canada H3A 2T8

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From ab initio calculations, interesting magnetic behaviors are found in pure and nitrogen-doped carbon atomic wires. Magnetic moment of $2\mu_B$ is obtained in wires with even number of carbon atoms, while the spin polarization disappears in the odd-numbered wires. Doped with one or two nitrogen atom(s), the wires exhibit spin-density-wave-like states. These magnetic behaviors can be rationalized through bonding patterns and unpaired states. After the wires are sandwiched between Au electrodes, perfect spin filtering effect is found by stretching slightly the wires. Our findings should be useful for exploring applications of spintronics in nanoscale carbon-based systems.

Unusual band-gap and band-edge bowing of SnGe alloy

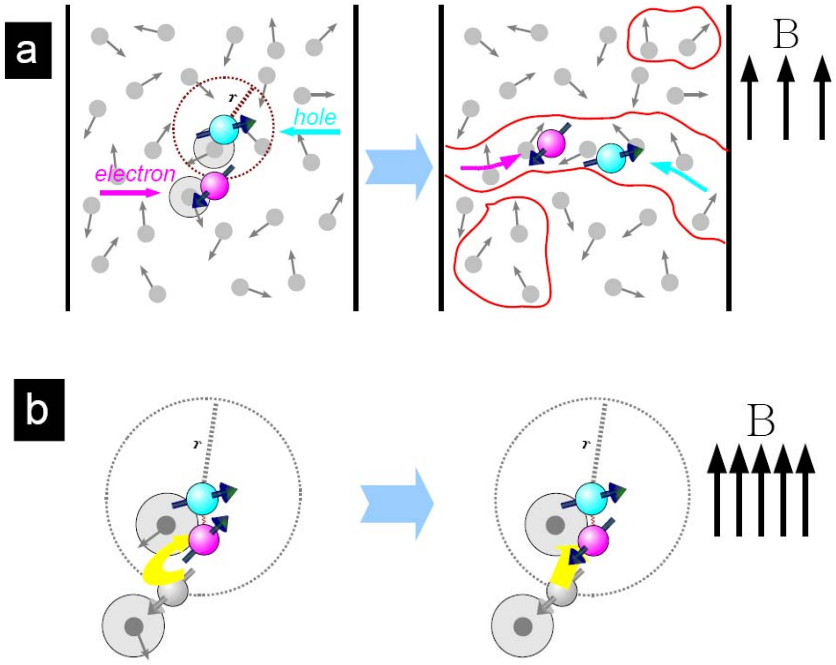
尹万健

A theoretical model on organic magnetic field effect

姚尧
Yao Yao and Chang-Qin Wu
Surface Physics Laboratory and Department of Physics, Fudan University, Shanghai 200433, China

We have studied the spin related exciton generation under magnetic field in organic light emitting devices, which is merely roughly discussed before. Our work provides an overall description on magnetoelectroluminescence, which may stimulate further studies on organic magnetoresistance.

There are two steps in the process of exciton generation (see figures below): I. formation of germinate electron-hole pair from free carriers; II. generation of exciton from electron-hole pair. Under magnetic field, two different mechanisms, spin scattering and spin mixing, dominate in step I and II, respectively. From our theoretical calculations, we find spin scattering will be mainly influenced by magnetic field which is comparable with hyperfine interaction, while spin mixing will be influenced when magnetic field is beyond hyperfine interaction. On the other hand, we also consider the quantum intermolecular correlation effect, described by hopping rate, which is the key factor of mobility, and find it has a universal influence in both steps. From our theoretical study, we predict two phenomena in MEL: 1) The decay of MEL under high field may be observed by getting sufficiently small intramolecular Coulomb repulsion; 2) The generation of singlet excitons are significantly influenced under low magnetic field, while few changes happen to triplet excitons.



The two steps of exciton generation in OLED

Flat metallic surfaces coated with periodically textured dielectric layers: a promising plasmonic system

Jian Zi
Department of Physics, Fudan University, Shanghai 200433, P. R. China

Plasmonics that relies on surface plasmon-polaritons (SPPs) is an emerging field of photonics. SPPs are charge density oscillations at metal/dielectric interfaces. Owing to the subwavelength and low dimensionality nature, highly complex miniaturized SPP-based photonic devices could be accomplished by controlling and manipulating light on nanometer scales.

In this talk, we will show some of our recent theoretical and experimental results of SPPs on flat metallic surfaces coated with periodically textured dielectric layers, such as SPP band structures and band gaps, SPP-based waveguides, negative refraction of SPPs, and directional enhanced fluorescence emission. Our results show that flat metallic surfaces coated with periodically textured dielectric layers manifest a promising plasmonic system.

Proper Scaling of the Anomalous Hall Effect

Xiaofeng Jin
Physics Department, Fudan University, Shanghai 200433, China

The anomalous Hall effect is one of the most prominent phenomena existing in magnetic materials. It has remained unsolved for more than a century because its rich phenomenology defies the standard classification methodology, prompting conflicting reports claiming the dominance of various processes. Working with epitaxial films of Fe, we succeeded in independent controls of different scattering processes through temperature and layer thickness. The resulting data appropriately accounted for the role of phonons, thereby clearly exposing the fundamental flaws of the standard plot of the anomalous Hall resistivity versus longitudinal resistivity. A new scaling has been thus established that allows an unambiguous identification of the intrinsic mechanism as well as the extrinsic mechanisms of the anomalous Hall effect.

Novel Electronic Structure Induced by a Highly Strained Oxide Interface with Incommensurate Crystal Fields

H. W. Ou[1,2], J. F. Zhao[1,2], Y. Zhang[1,2], B. P. Xie[1,2], D. W. Shen[1,2], Y. Zhu[1], Z. Q. Yang[1], J. G. Che[1], X. G. Luo[3], X. H. Chen[3], M. Arita[4], K. Shimada[4], H. Namatame[4], M. Taniguchi[4], C. M. Cheng[5], K. D. Tsuei[5], and D. L. Feng[1,2*]

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Abstract

The misfit oxide, $Bi_2Ba_{1.3}K_{0.6}Co_{2.1}O_{7.94}$, made of alternating rocksalt-structured [BiO/BaO] layers and hexagonal CoO_2 layers, was studied by angle-resolved photoemission spectroscopy, revealing the electronic structure of a highly strained oxide interface. We found that low-energy states are confined within individual sides of the interface, but scattered by the incommensurate crystal field from the other side. Furthermore, the high strain on the rocksalt layer induces large charge transfer to the CoO_2 layer, and a novel effect, the interfacial enhancement of electron-phonon interactions, is discovered.

Anisotropic diamagnetic Kepler Problem in solid state environment

周伟航

Optical and plasmonic metamaterials

周磊

Structure transition of polymer-mediated colloidal crystals

Chunrui Han et al.

Supervisor: Luwei Zhou

Department of Physics, Fudan University, Shanghai 200433, China

We experimentally demonstrate a novel method for fabricating colloidal crystals with abundant controllable crystalline structures by using free polymers and polymer brushes. We reveal that, with an increasing mass ratio of colloidal particles to free polymers, the crystalline structures undergo a series of transition in a controllable manner from amorphous, to polycrystalline, to columnar, to mixed square-hexagonal, to dense square, to mixed hexagonal-square, and to hexagonal structures. The optical reflectance spectrums of hexagon and square structures have been measured respectively. There are two peaks observed, one is corresponding to the square structure, the other is corresponding to the hexagon structure. The R-soft simulation has shown that the square structure is body-centered tetragonal structure and the hexagon structure is the face-centered cubic in three dimensions.

According to recent theoretical simulations by Ren and Ma, we understand that such controllable structures appear due to two important interactions: one is the steric packing effect of colloidal particles; the other is entropic effect of the polymer brushes.

Dissociation of excitons in the C60 ¯lm studied by transient photovoltage measurements

Xiaoyu Sun

Abstract

The dissociation of excitons at indium tin oxide (ITO)/C_{60} inter-face is studied by means of transient photovoltage measurements. An abnormal polarity change of transient photovoltage from positive to

negative upon pulsed laser irradiation is observed, indicating that the exciton dissociation at ITO/C_{60} interface results in holes injected into ITO and electrons left in the C_{60} ¯lm, opposite to that occurring at ITO/NPB and ITO/CuPc interfaces. It is con¯rmed that C_{60} has a moderately strong ability of donating holes to ITO during the dissoci- ation process of the excitons at the ITO/C_{60} interface. Moreover the long term transient photovoltage (/ 10ns) and its polarity can be tuned by applying external bias on the device, which further proves the validity of the model proposed to explain the polarity change of the transient photovoltage.

Nonlinear optical properties and ultrafast dynamics of undoped and doped bulk SiC

丁金亮

Jinliang Ding[a,b], Yaochuan Wang, Hui Zhou, Qiang Chen, Shixiong Qian[a)*]

a) Physics Department, Fudan University, Shanghai 200433, People's Republic of China

b) Surface Physics Lab (National Key Lab), Fudan University, Shanghai 200433, People's Republic of China

Ultrafast third-order nonlinear optical response of the undoped and doped with different nitrogen concentrations 6H bulk silicon carbide (SiC) were investigated utilizing femtosecond (fs) Z-scan and optical Kerr effect (OKE) techniques at the wavelength of 800 nm. In addition, the energy relaxation dynamics of SiC samples were studied by fs multiple-wavelength pump-probe technique. The Z-scan measurement showed that the third-order nonlinear optical susceptibilities of the doped samples are improved in comparison to the intrinsic sample. The OKE results additionally reveal that the instantaneous nonlinear optical response of the samples can be ascribed to the distortion of the electron cloud. The ultrafast transient spectroscopic measurement demonstrates the ultrafast recovery processes which are induced by two photon absorption(TPA) in the single color pump-probe experiments, and the slow relaxation components emerge under the excitation at bandgap.

Direct Observation of Chaos Induced Level Repulsion Effect in an Artificial Hydrogen System

周伟航

Weihang Zhou[1], Zhanghai Chen[1,2*], Bo Zhang[2], C. H. Yu[2], Jingbing Zhu[2], Wei Lu[2], S. C. Shen[2,1+]

1. *Surface Physics Laboratory, Department of Physics, Fudan University, Shanghai 200433, P. R. China*

2. *National Laboratory for Infrared Physics, Shanghai Institute of Technical Physics, Chinese Academy of Sciences, Shanghai 200083, P. R. China*

Abstract:

The analog of the hydrogen atom in solid state environment is realized by phosphorus doping in ultra-pure single crystal silicon. We study the bound impurity levels by means of high-sensitivity and high-resolution photo-thermal ionization spectroscopy techniques. The quantum chaotic dynamics of the impurity electrons is studied through level statistics approach. By scanning the magnetic field dependence of the level statistical features, we report the first experimental observation of the chaos-induced level repulsion effect in an artificial hydrogen system. The anisotropic properties of the system are also studied.

Electronic structures in $Eu_{1-x}La_xFe_2As_2$

周波

B. Zhou, Y. Zhang, L.X. Yang, H.W. Ou, J.F. Zhao, J. Wei, M. Xu, C. He, F. Chen, T. Wu, G. Wu, M. Arita, K. Shimada, H. Namatame, M. Taniguchi, X.H. Chen, and D.L. Feng

ABSTRACT

We report the high resolution angle-resolved photoemission spectroscopy (ARPES) studies of electronic structures of $EuFe_2As_2$, which is one of parent compounds of iron-based superconductors. $EuFe_2As_2$ has a Spin Density Wave (SDW)/structural transition at T_S=188K due to the magnetic ordering of Fe^{2+}, and another antiferromagnetic transition at T_N=20K due to the ordering of Eu^{2+}. In SDW state, our results show the band splitting, folding and hybridization, however, no gap formed at Fermi level is observed. Across T_N, no observable change within the energy resolution is observed, suggesting the interaction between the d electrons of Fe and the magnetic moments of Eu^{2+} is weak.

Er Si 共掺 ZnO 薄膜 1.54 μm 光发射特性的研究

王啸[1]，樊永良[1]，徐飞[2]，蒋最敏[1]

1 复旦大学表面物理国家重点实验室，上海 200433

2 上海大学理学院物理系，上海 200444

利用磁控溅射法，以热氧化 SiO_2/p-Si(100)作为衬底，通过交替生长 20 层 Er: ZnO 层（厚度：6 纳米）和 Si: ZnO 层（厚度：2 纳米）制备出 Er Si 共掺 ZnO 薄膜多层结构膜。研究了在不同退火温度下，多层结构薄膜中 Er^{3+}的 1.54 μm 光发射特性。研究表明，当退火温度达到 1000℃时，多层结构薄膜中 Er^{3+}的发光强度达到最大。同时作为对比，制备了总厚度与多层薄膜相同的 Er 掺杂 ZnO （Er: ZnO）薄膜。实验表明，多层结构薄膜在 1.54 μm 处的发光远强于不带纳米 Si 的 Er 掺杂 ZnO 薄膜。Er^{3+}的 1.54 μm 光发射增强特性归因于 Si: ZnO 层中的纳米硅宽带敏化剂传递能量给附近的 Er: ZnO 层中的 Er 离子这一纳米硅光敏化机制。并且，此时多层结构薄膜的 Er^{3+}光致发光特性呈现出一种非单调的温度效应。具体地，14K 到 50K 之间，强度几乎保持不变；随着温度的升高到 225K 时，强度达到最大值；接着呈短暂下降，而后随着温度升高再次有所增加。特别地，室温下的光致发光强度远强于 14K 的时候。

Quantitative study on the magnetic anisotropy in FeMn/Co/Cu(001) system

陈宫

摘要

铁磁-反铁磁界面的交换耦合作用是深入理解交换偏置现象（exchange bias）的关键之一，因此近年来受到理论和实验方面的极大关注。一般认为，由于其简单的自旋结构和界面结构，外延生长的单晶结构的铁磁-反铁磁双层膜结构，例如 Co/FeMn 体系，是研究铁磁-反铁磁耦合内在机制的理想体系。众所周知，单晶 Co/Cu(001) 体系具有四度对称的磁晶各向异性，其易轴方向为[110]方向。但是实验发现[1,2]，在 FeMn/Co/Cu(001)体系中，当 FeMn 由顺磁态相变为反铁磁态时， Co 磁畴中的磁矩方向会从[110]方向转为[100]方向。

旋转磁光克尔效应（Rotation Magneto-optic Kerr effect, 简称 RotMOKE）可以用来定量测量 FeMn/Co 薄膜中的面内磁各向异性。我们的实验结果表明，在 FeMn/Co/Cu(001)体系中当 FeMn 转变为反铁磁态时，10ML Co 薄膜的四度各项异性易轴方向由[110] 转为[100]。另外，在 Co/Cu(001),FeMn(PM)/Co/Cu(001) 和 FeMn(AFM)/Co/Cu(001)体系中，我们证实了 Co 膜的磁各向异性能大小随着 Co 厚度的变化满足 $1/d_{Co}$ 关系。定量研究转变过程中面内磁各向异性的变化，即通过拟合得到 FeMn 由顺磁态相变为反铁磁态的界面各向异性能的差异大小，将有助于深入理解这一体系中的交换耦合作用。

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Two Rules on Protein-Ligand Interactions

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摘要

Understanding the ruling principles of interaction between a target protein and a ligand is of paramount importance in drug discovery efforts. So far, in finding a real ligand for a given target protein, we are limited to experimental screening from a large number of small molecules, or through free energy calculation of assessing a ligand. However, we still lack a clear molecular mechanism to explain the protein-ligand interactions on the basis of electronic structure of a protein and guide novel molecules designing. Here we report two rules on the protein-ligand interactions using the full electronic structure calculation of a protein along with the perturbation theory of the interaction between two wave functions and the pocket calculation. One rule is the interaction only occurs between the lowest unoccupied molecular orbitals (LUMOs) of a protein and the highest occupied molecular orbital (HOMO) of its ligand, not between the HOMOs of a protein and the LUMO of its ligand. The other rule is only those residues or atoms located both on the LUMOs of a protein and in a surface pocket of a protein are activity residues or activity atoms of the protein and the corresponding pocket is the ligand binding site. Complexes FKBP12/FK506 and CypA/CsA were employed to validate our two rules. Results we obtained are in good agreements with experiments. These two rules are supposed to be new tools of drug design.

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Understanding the Folding of a Small RNA Hairpin: A Replica Exchange Molecular Dynamics Study

左光宏

摘要

The folding of a small RNA tetraloop hairpin is studied based on intensive molecular dynamics simulations, aiming to understand the folding mechanism of this small and fast RNA folder. The simulation results demonstrate that this RNA hairpin has very complicated folding behavior in spite of its small size. The folding transition has very low cooperativity, and the corresponding melting temperature is around 310K, which is consistent with experimental observation. Instead of a two-state folding, four major states are observed, including the native state, the intermediate, the unfolded state, and the misfolded state. Two folding pathways, passing through different substates of the intermediate, are observed during the folding transition. The pathway with the inboard basepair formed before the terminal one is more significantly populated compared with its counterpart. The misfolded state is compact and very stable, with rich nonnative hydrogen-bonds.

Fractal plasmonic metamaterials for subwavelength imaging

Xueqin Huang*, Shiyi Xiao, and Lei Zhou

Abstract

Surface plasmon polaritons (SPPs) are elementary electromagnetic (EM) excitations bounded at metal/dielectric interfaces, and attracted considerable attention recently. For a natural material, its plasmon frequency (ω_p) is fixed by the electron density, so that many SPP-based applications only work at a single frequency. Recently, people showed that Bragg scatterings can modulate the SPPs significantly, and found high optical transmissions in a silver film drilled with periodic holes [1]. However, the Bragg mechanism can not change the ω_p of a material. In 2004, Pendry *et al.* demonstrated that a metallic plate with periodic square holes can mimic a plasmonic metamaterial in terms of SPP properties. However, to make the idea work, one has to fill the holes with *high-index materials* [2], which is not easy to realize in practice, particularly at higher frequencies. Very recently, Shin *et al.* [3] showed that high-index insertion is not necessary if the square holes are replaced by closely packed narrow rectangle holes with cross sections. However, the generated SPPs on such structures *only* have transverse-magnetic (TM) polarization traveling along *one* direction.

We show that a metallic plate with fractal-shaped slits can be homogenitized as a plasmonic metamaterial with plasmon frequency dictated by the fractal geometry. Owing to the *all-dimensional subwavelength* nature of the fractal pattern, our system supports both transverse-electric and TM surface plasmons. As a result, this structure can be employed to focus light sources with *all-dimensional subwavelength* resolutions and enhanced field strengths. Microwave experiments reveal that the best achievable resolution is only $\lambda/15$, and FDTD simulations demonstrate that similar effects can be realized at infrared frequencies with appropriate designs.

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Resonance-induced extraordinary transparencies of waveguides at cutoff: a tight binding study

许昊

摘要：We employ a tight binding method (TBM) to explore the underlying physics behind the unusual transparency in metamaterial-loaded waveguides. Adopting appropriate hopping parameters, we find that the TBM quantitatively explained many interesting phenomena discovered previously by brute-force numerical simulations and experiments, including the number and positions of the transmission peaks，the parities of wave functions，the band width and the group velocities of the transmission bands，and the defect modes, ect.

Bragg Diffraction in Thin Two-Dimensional Gratings

何琼

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Abstract: Highly improved diffraction properties are demonstrated theoretically and experimentally in a two-dimensional grating formed by a thin transmission grating recorded in a Bragg reflector at the band edge of the reflection grating.

Summary: The optical signal processing requires compact and effective device with a good selectivity. The solution suggested here consists of the association between a thin transmission grating and a reflection grating or a Bragg mirror, with triple advantage at the band-edge of the device to obtain diffraction efficiency strongly amplified, a wavelength selectivity largely improved and Bragg diffraction regime. This principle was implemented in a transmission grating recorded in a Bragg mirror deposited on another mirror of Bragg. A very simple model employing a generalized 4x4 transfer-matrix method (TMM) has been developed to describe the diffraction properties of the 2D photonic crystal [1]. The design was validated by the experimental achievement of a transmission grating recorded in a semiconductor Bragg mirror (CdMgTe/CdMnTe) deposited on another Bragg mirror. The experimental setup was shown in Fig.1. Figure 2 shows bother the read beam reflectivity spectra recorded at high write fluence and in the linear regime with no write beams [Fig. 2(a)] and the net diffraction efficiency spectra of this read beam for the -1 and +1 diffraction orders [Fig. 2(b)]. The experimental results are in good agreement with numerical calculations resulting from the analytical model [2]. The comparison with the equivalent transmission gratings recorded in a homogeneous medium demonstrated the huge improvement in the diffraction properties when the read beam wavelength and incidence correspond to the band edge of the reflection grating or the Bragg mirror and satisfy the transmission grating Bragg condition: a huge enhancement of the diffraction efficiency (a factor of 40), a largely improved wavelength selectivity (a factor of 7060), and a Bragg diffraction regime with only one diffraction beam counter-propagating the read beam with a total thickness of 2.44 m. These results are very encouraging for the applications of optical signal processing: diffraction efficiencies very close to 100% can be obtained as well as high wavelength selectivity and a Bragg diffraction regime, despite the very small thickness of the sample and the low index modulation of the transmission grating.

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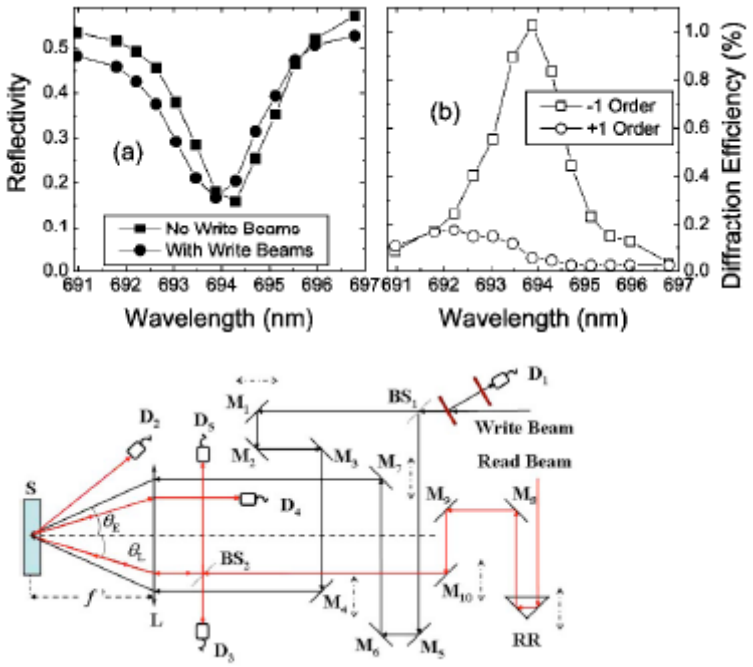
Fig. 1. Experimental setup Fig.2. (a) Reflectivity and (b) diffraction efficiency spectra.



Anomalous Hall Effect in Cobalt ultra-thin film

侯达之

Anomalous Hall Effect (AHE) in ultra-thin cobalt film is explored experimentally. Fcc phase of cobalt is stabilized on MgO(111) substrate, and hall bars of different thickness are defined by photo lithography to carry out transport measurement. By varying film thickness and temperature, the dependence of anomalous hall conductivity and longitudinal conductivity is observed. It is shown that at high temperature limit, the conductivity of films of various thickness merge to a universal point, which indicate an intrinsic contribution. Below 2nm, the longitudinal conductivity reaches maximum at some temperature and then rise in lower temperature range. This may indicate some weak-localization process happens in thin film limit.

掺铁硅基稀磁半导体薄膜的制备及其电学性质研究

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Ⅳ族稀磁半导体由于与传统半导体材料的兼容性，引起了人们的广泛关注。据报导，实验上已有 Mn_xGe_{1-x}、Mn_xSi_{1-x}、Fe_xGe_{1-x}、等稀磁半导体材料的制备及物理性质研究，但关于铁掺杂的硅基稀磁半导体却没有相关的报导。我们通过用分子束外延（MBE）的方法制备了不同 Fe 含量的 Fe_xSi_{1-x}、薄膜，并对其生长条件、结构、及其电学和磁学性质做了研究（其制备方法和结构的研究成果已发表在 J. Cryst. Growth）。本文主要研究 $Fe_{0.04}Si_{0.96}$ 薄膜的电学性质。

$Fe_{0.04}Si_{0.96}$ 薄膜是用 MBE 的方法在 P 型 Si（001）衬底上制备的，其厚度为 40nm，生长温度是 250℃。横截面试样高分辨率的透射电镜（图 1）观察表明 $Fe_{0.04}Si_{0.96}$ 薄膜的生长为外延生长，在薄膜中也没有观察到颗粒或团簇结构。二次离子质谱深度分布曲线（图 2）则说明了 Fe 在薄膜中沿生长方向分布均匀，并且 Fe 原子没有明显的表面偏析行为。

图 3 是薄膜的磁阻（MR=（R（3T）-R（0T））/R（0T））随温度变化的曲线，从图中可以看出 $Fe_{0.04}Si_{0.96}$ 薄膜在低温下有巨磁阻效应，并且在 30K 左右磁阻达到最大值。图 4 是薄膜的电阻率随温度变化的曲线，从曲线上我们可以很明显看出在不同的温区薄膜有着不同的导电机制。如图所示，在较低温度区激活能为 40meV，这说明 Fe 在 Si 中存在一个浅的受主能级；而在更低的温度区中，激活能则变为了 2.5meV。图 5 是在不同温度下测量的薄膜的霍尔（Hall）电阻率，在 30K 以下就可以看到很明显的反常霍尔效应，并且随着温度的降低，外推出的正常霍尔系数会改变符号，这意味着本来由空穴导电的薄膜在低温下会变成电子导电。图 4 中低温区的激活能或许可以说明这个问题，随温度的降低起导电作用的不再是浅的受主能级，而变为杂质带导电。

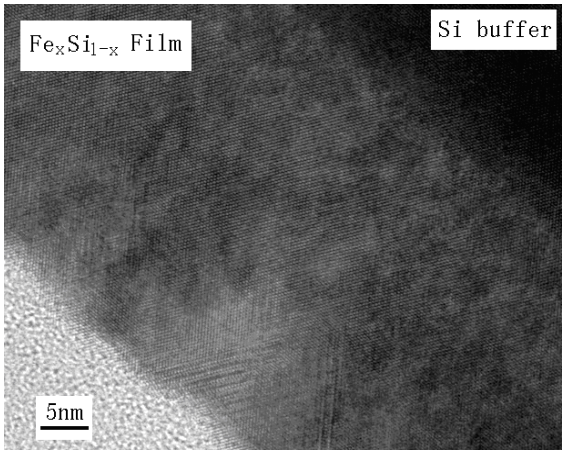

图 1：$Fe_{0.04}Si_{0.96}$ 薄膜的横截面试样高分辨率的透射电镜照片。

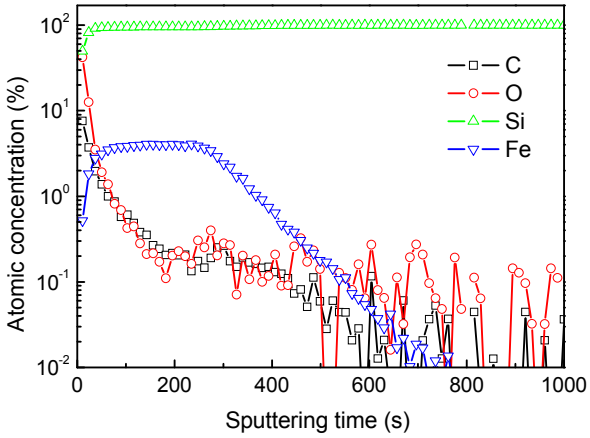

图 2：用二次离子质谱分析 $Fe_{0.04}Si_{0.96}$ 薄膜的组分

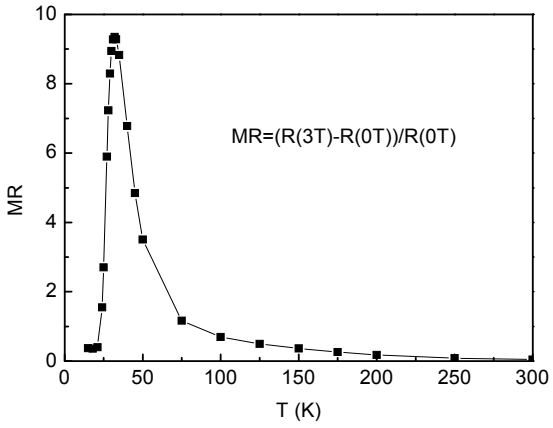

图 3：不同温度下磁阻的变化

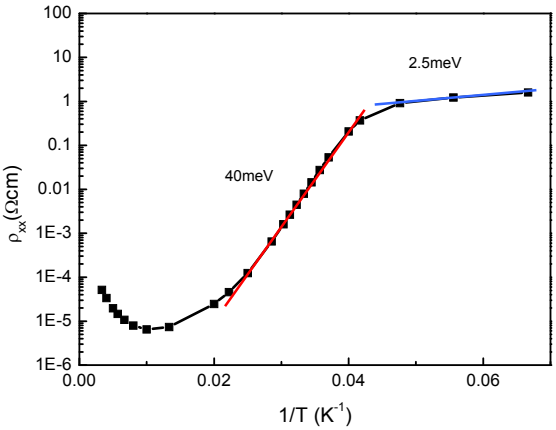

图 4：零磁场下电阻随温度的变化

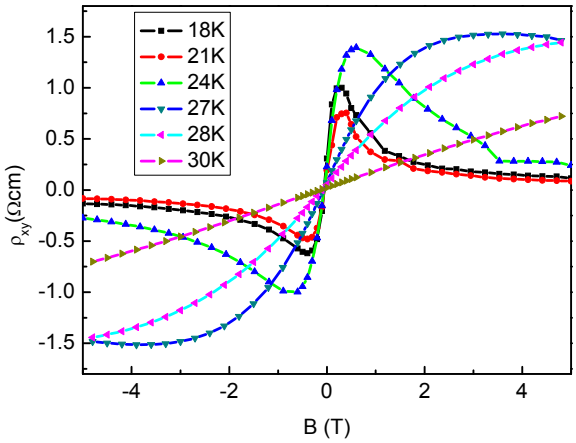

图 5：不同温度下薄膜的霍尔电阻率

(1-x)Pb(Fe1/2Nb1/2)O3-xPbTiO3 的 X 射线吸收精细结构研究

刘奎

摘　要

我们利用同步辐射 X 射线吸收精细结构(X-ray absorption fine structure, XAFS)的方法，对(1-x)Pb($Fe_{1/2}Nb_{1/2}$)O_3-x$PbTiO_3$ (PFNT)单晶的多种元素(Fe, Pb, Ti)进行了电子结构和局域结构的研究。Fe *K* 边的边前结构显示，Fe 的 3d 轨道发生了劈裂，除了晶体场劈裂导致的 t_{2g} 和 e_g 外，在 7111 eV 和 7117 eV 还各有一个吸收峰，分别对应着 Fe^{2+} 的 1s-3d 跃迁和 Fe^{3+}的 1s 电子到近邻过渡元素(Fe, Nb, Ti) d 轨道的跃迁。由于 FeO_6 八面体的扭曲较大，导致了 Fe 的 3d 和 4p 轨道的杂化。Fe *K* 边扩展 X 射线吸收精细结构(extended X-ray absorption fine structure, EXAFS)的结果显示，随着 Ti 掺杂浓度的提高，Fe-O 第一配位层的局域结构没有发生明显的变化，而 Fe-Pb 第二配位层的局域结构却非常不同。在低掺杂(x=0.07)的样品中，Fe 原子沿着[111]方向偏移，和 3 个 Pb 原子形成配位结构；在高掺杂(x=0.48)的样品中，Fe 原子沿着[001]方向偏移，和 4 个 Pb 原子形成配位结构。Pb L_3 边 EXAFS 的结果和上述原子构型一致。通过对 Ti *K* 边边前结构的分析，研究了边前各个吸收峰所对应的电子跃迁，并发现 Ti 掺杂浓度越高，Ti 偏离 TiO_6 八面体中心的距离越大。

人体穴位处微量元素分布情况

黄隽尧

摘要

中医作为中华民族的传统医学，有着完全不同于现代临床医学的理论体系。其中之一就是著名的经络腧穴理论。经络学说是研究人体经络系统的循行分布、生理功能、病理变化及其与脏腑相互关系的一种理论学说。它是祖国医学理论体系的重要组成部分。经络学说是古代医学家在长期的医疗实践中总结和发展起来的,多少年来一直指导着中医各科的诊断和治疗,其与针灸学科关系尤为密切。

虽然中医医学治病救人的作用已经被无数次地证实过了，但是中医理论体系对疾病治疗的机理的描述过于抽象，且很多都是经验总结，所以人们对中医理论体系的物质基础始终没有搞清楚。尤其是中医的经络理论，尽管疗效显著，但对其始终没有一个科学合理的解释。甚至有很多人怀疑经络与腧穴是否真的存在。

微量元素在人体内含量不多，但是对于人体生理机能和新陈代谢的维持有着重要的作用。它们广泛地存在于人体内各个组织中，参与各种生命过程。可以预见，微量元素与经络腧穴的功能之间可能有着十分密切的联系。已经有实验表明，钙元素参与了使针刺穴位产生疗效的过程。清楚了解这些元素的作用是经络研究的一个重点方向。

X 射线荧光分析法是一种非常快速准确的元素分析法，它具有敏度高、非破坏性、快速、设备简单等优点。已经广泛应用于探测生物样品中微量元素的分布情况。通过 X 射线荧光分析实验，我们发现在人体穴位处存在钙，铁，锌元素的富集现象。钙、铁、锌都是人体内不可或缺的微量元素。它们在穴位出的富集表明了穴位点是人体中一些特殊的点，这些元素很可能参与了针刺穴位点产生疗效的过程。此外，非穴位区的微量元素富集点，可能是未经记载的新的穴位。因此，可以用荧光分析法作为穴位定标的一个指标。

Local atomic structure in acupuncture points studied by Fe *K*-edge EXAFS

张冬明

Abstract

Traditional Chinese acupuncture is becoming increasingly popular in western countries but its underlying anatomy and physiology have not been characterized. On the other hand, structural studies are very important for understanding the nature of biological properties in biology system all the time. In this work, Extended X-ray Absorption Fine Structure (EXAFS) of Fe *K*-edge was used to investigate the Fe local atomic structures of acupuncture points (acupoints) and non-acupoints of human beings. Acupoints samples of Guanyuan, Neiguan and Sanyinjiao were got from anatomical experts of The Second Military Medical University, China. Besides, the EXAFS spectra were collected at BL13B of Photo Factory (PF) of High Energy Accelerator Research Organization, Japan. Apart from the nitrogen neighbors around the central iron atom, oxygen neighbors were also investigated. Not only did we find that the Fe-O mean coordination numbers were obviously different between acupoints and non-acupoints, but also we found that the Fe-O and Fe-N bonds length increased in those samples from acupoints to non-acupoints. With the increase of Fe-N bond length of non-acupionts, the ability of transporting oxygen decreases. As a result of the change of Fe-O coordination number and the Fe-O bond length from acupoints to non-acupoints, there must be a close relationship between the N-Fe-O combinative structure and the difference of obvious structure and function in and out of acupoints.

Topological quantum phase transition in the extended Kitaev spin model

施小锋

摘要：

We study the quantum phase transition between Abelian and non-Abelian phases in an Extended Kitaev spin model on the honeycomb lattice, where the periodic boundary condition is applied by placing the lattice on a torus. Our analytical results show that this spin model exhibits a continuous quantum phase transition. Also, we reveal the relationship between bipartite entanglement and the ground-state energy. Our approach directly shows that both the entanglement and the ground-state energy can be used to characterize the topological quantum phase transition in the extended Kitaev spin model.

Transport property of Bismuth thin film

肖顺豪

摘要

In this work, temperature dependent resistivity and Hall Effect of bismuth (Bi) ultrathin films were measured. By changing film thickness, bismuth exhibit different transport behavior. Our results indicated that in ultrathin bismuth films, the transport property is determined by two parts: metallic surface state and semiconductor bulk.

利用导纳谱测量半导体中浅能级的研究

袁豪

摘要：

主要研究了利用导纳谱应用测量半导体中浅能级的理论计算。导纳谱是一种很强大的电学测量方法。在 77K-300K 温度范围内，通常被运用于测量半导体中的深能级，但是在利用导纳谱测量浅能级方面至今没有很系统的研究。本文的目的就是想通过浅能级导纳谱曲线的理论模拟，而后确定一种分析浅能级的最佳方法。在模拟中，所采用的统一模型中同时考虑了肖特基势垒电容和衬底电阻。最后，通过分析理论模拟的曲线，确定了 $\omega_r \propto \exp(-Ea/k_0T)$ 为最佳的分析方法，同时对于硼和磷的实验数据的计算分析也表明这种方法的正确性。

Thermodynamics and dynamics of amyloid peptide

oligomerisation are sequence-dependent

卢岩

Abstract: More than 20 human diseases are associated with the pathological self-assembly of soluble proteins into cytotoxic oligomers and amyloid fibrils. Two peptides from β_2-microglobulin and amyloid-β peptide are selected to study the thermodynamics and dynamics of amyloid peptide oligomerisation by MD simulations. Based on multiple trajectories runs, we find that the two peptides share common, but also very different aggregation properties. Notably, an increase in the hydrophobic character of the peptide, as observed in Aβ16-22 with respect to β2m83-89, impacts the thermodynamics by reducing the population of amyloid-competent assemblies. Higher hydrophobicity is also found to slow down the dynamics of β-sheet formation by enhancing the averaged life time of all the aggregates and by reducing the complexity of the transition probability matrix between all configuration types.

新型铁基超导体母体化合物BaFe2As2在自旋密度波态的电子结构和能带劈裂

杨乐仙

Abstract

The magnetic properties in the parent compounds are often intimately related to the microscopic mechanism of superconductivity. Here we report the first direct measurements on the electronic structure of a parent compound of the newly discovered iron-based superconductor, $BaFe_2As_2$, which provides a foundation for further studies. We show that the energy of the spin density wave in $BaFe_2As_2$ is mainly lowered through exotic exchange splitting of the band structure.

不同结构荧光量子点在细胞内的光稳定性比较研究

马奇锋

摘要

用量子点来做荧光示踪标记和肿瘤光动力治疗（PDT）是光生物医学方向一个很重要的领域和应用。本工作主要是比较直接用硫醇包裹的 CdTe 量子点和锌壳结构的 CdTe 量子在癌细胞中的荧光特性的比较研究。通过比较分析两种量子点在肿瘤细胞内的光漂白情况和测量荧光寿命来说明他们在细胞内的呃光稳定性，还可以通过测量他们的荧光量子产额来说明两者的 PDT 作用效果的差别。

利用超导量子器件实现绝热量子计算

项泽亮

摘要：
本工作就当前热门的超导量子器件与绝热量子计算进行研究，利用超导量子器件为基础构建能实现绝热量子计算的电路模型。在实际计算中，已经能够有效地解决计算机 NP-Complete 问题中的 Max-Cut 问题，并对大数分解以及搜索问题也有了一些结果。其中设计的超导量子器件电路具有很好的可调性，较一般可调性差的实现模型有着较大的优势，并在实验中也容易实现，是一种很好的实现绝热量子计算的实验模型。

Single crystal growth of Ln2Ti2O7 by Floating-zone method

董金奎

Abstract

Materials containing antiferromagnetically-coupled magnetic moments which reside on geometrical frustrated lattices often exhibit unusual behavior at low temperature. Large, high quality, single crystals of Ln2Ti2O7（Ln=Tb，Ho，Dy）, have been successfully grown by the floating zone method under a controlled atmosphere. Stoichiometric feed rods were prepared with Hydrostatic-Press-System(at the pressure of 70MPa) and Vertical Molysili Furnace which is equipped with Rotational Lifter. The seed and feed rods were counter-rotated at the speed of 15 rpm and moved through the hot zone at 0.5 mm/h. The growth was carried out under over pressure of oxygen.

Optical property and biological use of gold nanocubes

吴西

摘要

The amusing optical property of various gold nanoparticles and its protantial use in biology has being study wildly in recent years. To verify the sharp and size of gold nanoparticles, we can change its absorption and emission. And some of proper gold nanoparticles can be useful in cell imaging or photo-thermal-thearpy since gold have good biological safety.

We have find that gold nanocubes showed extremely high photoluminescence(PL) yeild. Approximately 100 times higher than gold nanorods, which is the highest among gold nanoparticles we had ever know, ie its measured quantum efficiency is 8 orders of magnitude higher than that observed for the emission from the bulk metal surface. The application of gold nanocubes as SPL imaging agents is demonstrated by in cell imaging of nanocubes. Also, nanocube can be used for photothermal cancer therapy due to its strong absorption of electromagnetic radiation .

Anyons from fermions with conventional two-body interactions

李易

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Emergent anyons are the key elements of the topological quantum computation and topological quantum memory. We study a two-component fermion model with conventional two-body interaction in an open boundary condition and show that several subsets in the low-lying excitations obey the same fusion rules as those of the toric code model. Those string-like non-local excitations in a given subset obey mutual semionic statistics. We show how to peel of one of such subset from other degenerate subsets and manipulate anyons in cold dipolar Fermi atoms or cold dipolar fermionic heteronuclear molecules in optical lattices by means of the established techniques.

Magneto-optical Kerr effect in perpendicularly magnetized Co/Pt films on two-dimensional colloidal crystals

刘尊

摘要

We have studied the magneto-optical Kerr effect and optical reflectance of perpendicular magnetized Co/Pt films on self-assembly two-dimensional polystyrene spheres. It is shown that the magneto-optical and the reflectance spectra are correlated to each other. Calculations have shown that the magneto-optical Kerr rotation and the Kerr ellipticity spectra are governed by the resonant coupling of light to the excitations of surface Plasmon polaritons and modified by the sphere diameters. These effects lead to the possibility of developing new magnetoplasmonic nanosensors.

Electrical and Optical Characterization of proton-irradiated GaInP/GaAs/Ge triple-junction solar cells

张希

摘要

Abstract: GaInP/GaAs/Ge triple-junction solar cells were irradiated by low-energy protons, and the induced defects distribute in the cells, depending on the energy of protons. Optical deep level transient spectroscopy (ODLTS) technique has been used to measure defects in the top two sub-cells separately. Three samples, irradiated by 100 keV, 130 keV, and 170 keV protons, were measured. In the n^+/p GaInP top sub-cells, the concentrations of majority-carrier (hole) defects decrease as the proton energy increases. In the n^+/p GaAs middle sub-cells, the concentrations of majority-carrier defects increase as the proton energy increases. This variety of concentration as proton energy agrees with the distribution of radiation-induced defects by computational simulation. Impedance spectroscopy measurements were also carried out to characterize the three individual sub-cells. For each one sample, based on a simple equivalent circuit model, the capacitance and resistance of each sub-cell junction were calculated by fitting. Four samples (irradiated by 40keV, 100 keV, 130 keV, and 4 MeV protons) were measured, and the results also agree well with the computational simulated distribution of radiation-induced defects.

双幻数有限核及奇异核的研究

吴琛

摘要

原子核由质子和中子构成，自然界发现质子或中子在某个整数时，原子核特别稳定，同时在自然界的丰度也特别高。我们把这个整数叫做原子核的幻数，比如8，20，28，50，82。当中子和质子的数量都为幻数时，原子核成为双幻核，比如氧-16，它的质子和中子都是 8。由于双幻核的结构相对简单，可进行精确的理论处理。改进的夸克质量密度相关模型是最近发展起来的相对论平均场模型，我们希望它能够得到实验的检验。用双幻数原子核的实验数据能够帮助我们确定模型的自由参数。我们自恰求解了核子的狄拉克方程与介子场方程，得到了核子的壳层型的能级，同时计算了原子核的半径和平均结合能。我们希望下一步能够把研究拓展到奇异核与超重核，这是原子核的研究前沿，是一个能够用理论模型预言实验和指导实验的研究领域。

Thermodynamics and finite-size scaling of homogeneous weakly interacting Bose gases within an exact canonical statistics

王建辉

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The thermodynamic properties and finite-size scaling of weakly interacting Bose gases with a finite number of particles confined in a cubic box of volume L^3 with periodic boundary conditions are investigated theoretically based on an exact recursion relation for the canonical-ensemble partition function. In a similar manner to the case of an ideal Bose gas, the recursive scheme of the interacting finite system at any temperatures is established in the framework of the Bogoliubov theory. The temperature dependence of the condensate fraction and specific heat with different particles and interactions is obtained numerically. By defining two different transition temperatures of the finite systems, the effect of interactions on the transition temperatures yields the different and nonmonotonous behaviors. The finite-size scaling condensate fraction at the transition temperature for the systems is also discussed. It is shown that the calculated finite-size scaling is universally independent on the various system sizes and transition temperatures.

Herd Behavior Based On Market-Directed Resource Allocation Game

赵璨

摘要

L. Zhao, W. Wang, J. P. Huang, Y. Chen

The phenomenon of herding is very general in collective behavior of many species, including human beings. It pertains to human conduct during activities such as stock market, fashion world and even everyday decision making, judgment and opinion forming. In order to study the herd effect, we introduce a type of imitating agents in the Market-Directed Resource Allocation Game (MDRAG). Unlike the normal agents, the imitating agents do not occupy strategies, but just mimic others' behavior. Our results show that when the market environment is simple, the imitating herd will cause large fluctuations, which is related to "crowed effect“. However, as the environmental complexity increases, the imitating agents will form a kind of adaptive herd, improving the efficiency and stability of market.

Fabrication and application of pit-patterned Si (001) substrate via nanosphere lithography

陈培炫

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Due to their unique electronic, optical, catalytic, and biological properties, well-ordered nanostructures have attracted enormous interest. They have potential applications in photonic crystal devices, large-density magnetic recording devices, novel electronic devices, synthesis of DNA electrophoresis mediate, and so on. In particular, extensive effort has been devoted to Si-based nanostructures since Si is the base materials in the present semiconductor industry. However, the fabrication of nanostructures in a regular arrangement over large areas is a major challenge in modern nanotechnologies. Fortunately, in combination of top-down lithography techniques and bottom-up self-assembly growth, well-ordered nanostructures can be obtained on patterned Si substrates. For example, a two-dimensional (2D) ordered array of Au particles on Si(111) substrates can give rise to ordered Si single-crystal nanowires. In addition, long-range ordered coherent islands can be realized by self-assembling islands on 2D pit-patterned Si substrates. Up to now, 2D ordered patterns have mainly been fabricated by holographic lithography, electron-beam lithography, and ion-beam lithography. With the first method, the feature size is in general comparable to the wavelength of light used for exposure. Moreover, the periodicity of the pattern is limited by the wavelength. Recently, a new extreme ultraviolet (EUV) lithography has been developed, which is a potential candidate for achieving critical dimensions below 100 nm. However, it still has some problematic issues, such as the EUV light source and the complication of the optical system. The other two methods have low throughput and require expensive equipment. So it is necessary to develop new technologies to facilitate pattern fabrication. Great efforts have been devoted to investigate alternative nanolithography approaches. One of promising methods is nanosphere lithography, in which self-assembled monolayer of spheres on substrates were used as a template for further fabrication of ordered patterns. This technique is characterized by its low cost, high throughput, and easy manipulation for producing large-scale periodic patterns.

In this study, a new method of fabricating a pit pattern on Si substrates using nanosphere lithography has been developed. The fabrication processes start with self-assembling a monolayer of polystyrene (PS) spheres on hydrogenated Si(001) substrates. A novel net-like mask in combination of the Au pattern thermally evaporated in between the PS spheres and the Au-catalyzed SiO_2 around them is naturally formed. After selective etching of Si by KOH solution, 2D ordered pits with a periodicity equal to the diameter of the PS spheres in the range from micrometers to less than 100 nm can be obtained. The shape of the pits can be modulated by controlling the

chemical etching time. Such pit-patterned Si substrates facilitate the formation of 2D or 3D ordered GeSi quantum dots.

High Transmission through Epsilon-Near-Zero Metamaterial

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The optical properties of a metamaterial consisting of thin layers of alternating positive and negative permittivity are investigated. This metamaterial will respond to electromagnetic radiation as a homogeneous effective medium with anisotropic dielectric permittivity[1,2], at least in the long wavelength limit. When electric field is perpendicular to this 1D periodic structure along lateral direction, the behavior of this system becomes very interesting: the existence of resonance phenomenon definitely leads to the occurrence of high index at some specific frequency, which is very scarce in natural material. We can tune the resonance frequency either by altering the plasma frequency of metallic mesh structure or by changing the ratio of layer thicknesses. Furthermore, the thing which makes us amusing is that high transmission is observed in ABA structure[3] by this resonance. Using finite-difference-time-domain (FDTD) simulation, we design a metallic net structure to realize this idea. In the near future, microwave experiments will be performed to verify our predictions.

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Effective medium theory for anisotropic magnetic metamaterials

靳俊凤

摘要

We expanded the effective medium theory to anisotropic material whose parameters are determined by the magnetic field. We calculated the effective permittivity and permeability within the effective medium theory. The photonic band structures are calculated also to verify our theory and we found they filled very well. In addition, the range in which the effective medium theory applied perfectly. At last we simulated the field intensity of the material and found it is perfect.

Analytical calculation of axial optical force on a Rayleigh particle illuminated by Gaussian beams beyond the paraxial approximation

陈君

摘要

We investigate the optical trapping of a Rayleigh particle by a linearly or radially polarized Gaussian beam beyond the paraxial approximation based on a description of beam by the mixed dipole model. The Mie theory is applied to abtain a full solution, and the approximate analytical expressions for the optical force, equilibrium position, and trap stiffness are presented for a Rayleigh particle. Our results suggest that at equilibrium the displacement of the particle from the focus scales like a^3 (where a is the radius) for a transparent particle, owing to scattering, while for an absorptive particle it scales like $C+Da^2$, owing to absorption. The trap stiffness is found to be proportional to a^3, in good agreement with the recent experiment. In addition, the radially polarized trapping beam is shown to be superior to the linearly polarized one in the Rayleigh regime as far as their trapping capabilities are concerned.

Transformation media for linear liquid surface waves

杨炯

Abstract

We extend the transformation media concept to the linear liquid surface waves. A mapping is introduced to generate an anisotropic depth parameter that corresponds to the anisotropic permittivity tensor in electromagnetic waves. A device that can rotate the liquid wave front is introduced, which is an analog of the metamaterial electromagnetic wave field rotator. The structure is based on a layered design. Simulation results are compared with experimental measurements.

28-35 ABETA 片段与膜的相互作用机理研究

常钟文

摘要

ABETA 是由 39-43 个氨基酸缩合成的多肽，也是阿尔海默症病人脑中淀粉样沉淀的主要组成部分。这些沉淀是由天然形成的 ABETA 单体通过一系列二级变化以及蛋白质折叠最后形成纤维状多聚体。这一过程经实验发现，能被带电的膜分子加速，但因为其变化迅速，无法由实验得到动力学变化过程，本工作拟用分子动力学模拟，选择带正电荷的 28-35ABETA 片段与带负电的 POPG 膜进行模拟计算，希望能得到 ABETA 被膜加速的动力学过程，从而为研究并解决淀粉样沉淀的机理奠定基础。

Photonic dipole oscillations in photonic crystals

王钢

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The occurrence of photonic dipole oscillations in electrically tunable photonic photonic crystals is investigated theoretically. Because of the modulation of the graded pump electric fields, optical pulse undergo oscillations inside the curved band structure, in analogous to the dipole oscillations in ultracold gases. The transition from photonic dipole oscillations to photonic Bloch oscillations can be readily achieved by tuning the incident frequency and the conditions for such transition are discussed. The results offer potential tools with widely tunable parameters for controlling light.

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锰掺杂与铁掺杂硅薄膜微结构研究

王佳乐[1]，苏卫锋[1]，徐闰[2]，樊永良[1]，蒋最敏[1*]
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锰掺杂与铁掺杂硅材料由于被认为可以作为很有发展前景的铁磁半导体（FMS）材料而得到越来越多的研究。而锰硅化合物由于具有大的 Seebeck 系数，可以作为热电器件材料得到广泛研究，同时低温β相 $FeSi_2$ 由于它的直接带隙特性以及和现有硅工艺的相容性，也得到了广泛关注。所以，了解这类材料的微结构对于材料生长和了解它们的物理性质是非常重要的。拉曼光谱和双晶 x 射线衍射（DCXRD）对于研究这类材料提供了一个非常有力的工具。

在本文中，我们用拉曼光谱和双晶 XRD 研究了锰掺杂与铁掺杂硅薄膜，首次确定了锰硅化合物的两个相，$MnSi_{1.73}$ 和 MnSi，与传统 XRD 方法相比，拉曼光谱对于这一类物质结构更加灵敏。另外，我们从双晶 XRD 可以发现，随退火温度提高，锰或铁在硅薄膜的晶格中由填隙位置变为替位位置。另外，从拉曼光谱中可以看到，随退火温度不同，形成的 $MnSi_{1.73}$ 或β-$FeSi_2$ 化合物的量并没有明显变化。

锰掺杂与铁掺杂硅薄膜都由分子束外延（MBE）生长在 Si(001)衬底上，生长温度为 200 ℃，薄膜厚度为 80nm，随后在真空环境下不同温度退火。

图 1 为不同退火温度下锰掺杂硅薄膜拉曼光谱，图 1（a）样品锰含量为 10%，图 1（b）样品锰含量为 50%，刚长完的样品薄膜是非晶的，退火后，在图 1（a）中可以看到在 276，301 和 318 cm^{-1} 有 3 个明显的峰，它们是 $MnSi_{1.73}$ 的特征峰。在图 1（b）中可以看到在 299，321，376 和 661 cm^{-1} 有 4 个明显的峰，它们是 MnSi 的特征峰，同时，在 480，576 和 625 cm^{-1} 的一些比较弱的峰，我们也认为是 MnSi 的特征峰。

图 2（a）为不同退火温度下铁掺杂硅薄膜双晶 XRD 图，铁含量为 5%，在 Si（400）峰的右侧突起为填隙铁原子引起，而 Si（400）峰左侧突起为替位铁原子引起，因为铁相对于硅有更大的原子半径。从中可以看出，随着退火温度提高，在 700℃和 800℃时，铁作为填隙原子，而在 900℃时铁变成了替位原子。这是由于在低温时，铁原子的能量还不足以让它占据硅的晶格位置，所以此时只能作为填隙原子，而当温度升高时，铁原子有了足够能量以让它占据硅的晶格位置成为替位原子。图 2（b）为不同退火温度下铁掺杂硅薄膜的拉曼光谱。从图中我们可以看出，刚长完的薄膜是非晶的，随着退火温度的升高，520cm^{-1} 所对应得硅声子峰逐渐变强，说明薄膜的结晶变好，175，193,198,247 cm^{-1} 所对应的是β-$FeSi_2$ 相的峰，但是我们可以发现，随着退火温度的升高，对应于β-$FeSi_2$ 相的峰的峰强并没有明显变化。我们认为，在铁掺杂硅薄膜中，铁存在两种电子态，即大部分的 Fe 零价态和小部分的 Fe 非零价态，Fe 非零价态在比较低的退火温度下就能和硅发生反应生成铁硅化合物，所以随着退火温度的升高，β-$FeSi_2$ 相的峰的峰强并没有明显变化。同样的现象我们可以从图 2（c）和图 2（d）锰掺杂硅薄膜双晶 XRD 图和拉曼光谱中得到，其中锰含量为 3%，我们同样可以看到退火温度的升高，$MnSi_{1.73}$ 相的峰的峰强并没有明显变化。

图 1（a）锰含量为 10%的锰硅化合物薄膜拉曼光谱，276，301 和 318 cm^{-1} 为 $MnSi_{1.73}$ 的特征峰。(b)锰含量为 50%的锰硅化合物薄膜拉曼光谱，299, 321, 376, 480, 576, 625 和 661 cm^{-1} 为 MnSi 的特征峰。

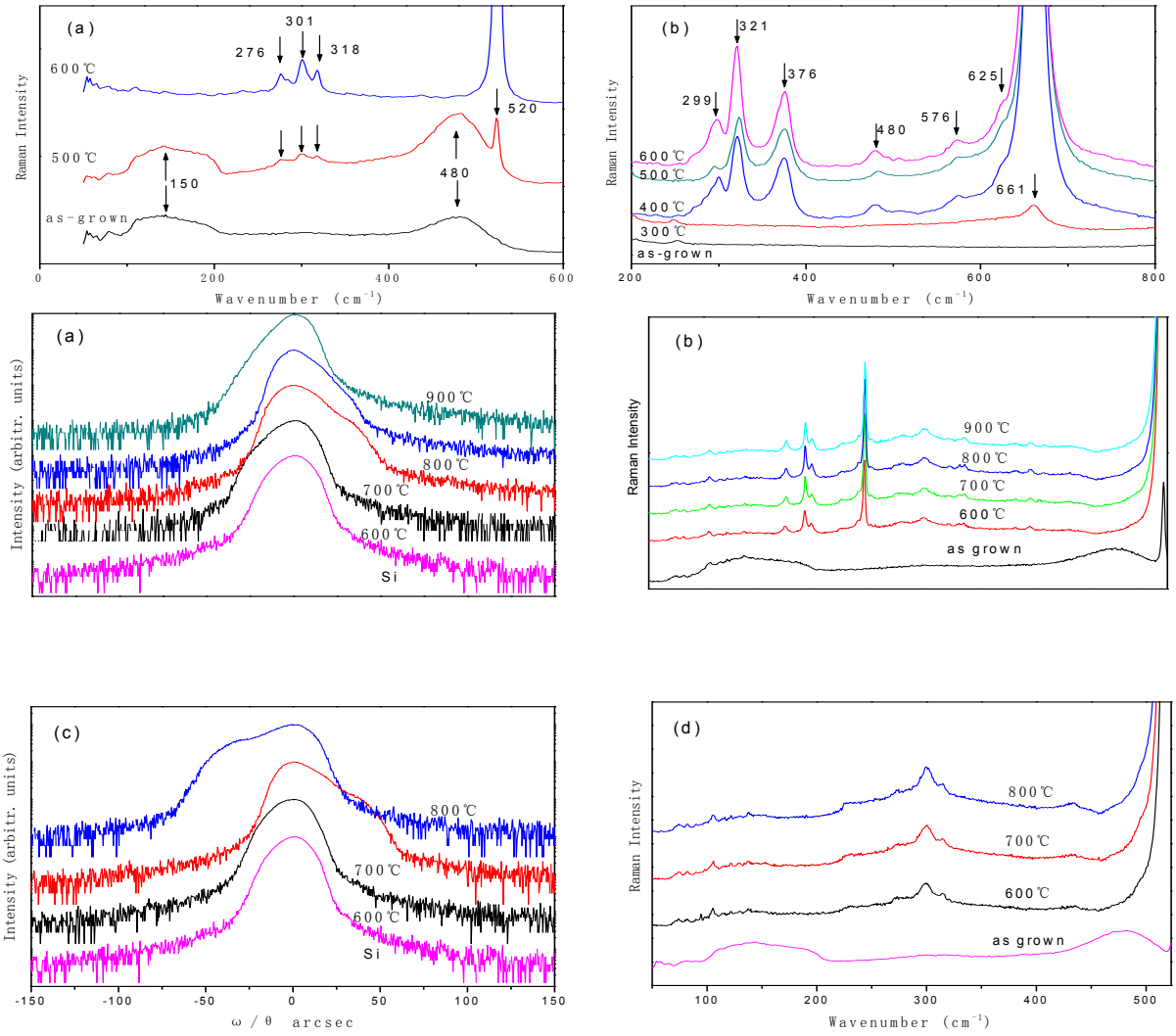

图 2（a）不同退火温度下铁掺杂硅薄膜双晶 XRD 图，在 700℃和 800℃时，铁作为填隙原子，而在 900℃时铁变成了替位原子。(b)不同退火温度下铁掺杂硅薄膜拉曼光谱，随着退火温度的升高，对应于 β -$FeSi_2$ 相的峰的峰强并没有明显变化。（c）不同退火温度下锰掺杂硅薄膜双晶 XRD 图，在 700℃时，铁作为填隙原子，而在 800℃时铁变成了替位原子。(d)不同退火温度下锰掺杂硅薄膜拉曼光谱，随着退火温度的升高，对应于 $MnSi_{1.73}$ 相的峰的峰强并没有明显变化。

新型铁基高温超导体的比热性质研究

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新型铁基高温超导体的发现给超导研究带来了新的机遇和挑战。通过化学掺杂（如用 F 取代 O），一系列四元稀土过渡金属砷化物 LnOFeAs（1111 体系） (Ln=La, Sm, Ce, Nd, Pr 和 Gd)被发现具有超导电性，其中的 $SmO_{1-x}F_xFeAs$ 具有迄今为止铁基高温超导体中最高的超导转变温度 55 K；而 AFe_2As_2（122）体系也表现出类似的磁性和超导特性。我们对一系列 $SmO_{1-x}F_xFeAs$ 和空穴型掺杂的 $Ba_{1-x}K_xFe_2As_2$ 和 $Ca_{1-x}Na_xFe_2As_2$ 样品的比热性质进行了系统研究：

1）对氟掺杂的铁基砷化物 $SmO_{1-x}F_xFeAs(0 \le x \le 0.2)$的比热测量表明，未掺杂(x=0)的母体样品在 130K 附近观察到的比热跳变对应着结构/自旋密度波的相变，此跳变随着 F 离子的掺杂(x = 0.05)而迅速消失。对于超导样品（x = 0.15, 0.2），可以在 Tc 附近看到一个清晰的比热异常，而在同类的 $LaO_{1-x}F_xFeAs$ 中并没有，表明 $SmO_{1-x}F_xFeAs$ 可能具有更高的超流密度。另外，对于所有样品我们在 4 K 附近都发现了一个很高的比热峰，这可以归结为 Sm^{3+} 离子的反铁磁有序引起的。（*Physical Review B* **77** 180510 2008）

2）对 $BaFe_2As_2$ 高质量单晶样品以及超导的 $Ba_{0.5}K_{0.5}Fe_2As_2$ 和 $Ca_{0.5}Na_{0.5}Fe_2As_2$ 两个多晶样品的比热测量表明：单晶母体 $BaFe_2As_2$ 在 136K 有一个非常尖锐的比热峰，可以归结为此处的结构和反铁磁转变。对于空穴掺杂的 $Ba_{0.5}K_{0.5}Fe_2As_2$ 多晶样品，在 C/T～T 图中可以看到在超导转变温度 Tc~36K 处有一清晰的比热峰。而对于超导温度较低的 $Ca_{0.5}Na_{0.5}Fe_2As_2$ 多晶样品并未在超导转变温区观察到比热异常。通过低温数据的拟合我们得到了这些样品的电子比热系数γ和德拜温度Θ_D。（*New Journal of Physics* **10** 123031 2008）

Effective-medium properties of meta-materials: A quasi-mode theory

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In the spirit of the generalized coherent potential approximation, we applied a "quasi-mode" method developed in [1] to study the effective media properties of electromagnetic (EM) meta-materials. Embedding the meta-material under study into a background medium with tunable permittivity and permeability, we calculate the Green's functions of EM waves traveling inside the medium by considering the scatterings caused by the meta-material. The density of states (DOS), the self-energy, and the mean free path of a mode can be calculated with the knowledge of the Green's function given. The effective permittivity and permeability of the meta-materials can then be determined by maximizing the DOS, which is a function of the permittivity and permeability of the background medium. Compared with the standard S-parameter retrieval method [2], the present approach overcomed the multiple solution problems that exist in previous methods. Moreover, the "mean free path" obtained in present method is helpful to judge qualitatively how good are the effective medium parameters that we obtained for the meta-materials. As the illustrations of our theory, we performed numerical calculations based on the finite element method to study the effective-medium properties of both split ring and metallic wire resonators.

References:

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Bipolaron in organic electroluminescence

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Abstract:

In conducting polymer, besides single charged polarons (P), double charged bipolarons (B) are also carriers. A positive B can attract a negative B to form a biexciton, which is emissive. Since this luminescence channel does not involve triplet exciton, it is able to enhance the electroluminescence efficiency. The dynamical evolutions and transition probabilities of this luminescence channel are quantitatively studied in this paper.

Surface plasmon modified photo-electrochemistry

朱晓龙

摘要

The surfaces of metal electrodes used in photo catalysis and solar cells are usually flat, which largely limits the efficiency of light absorption due to their high reflection. If textured metal electrodes are used, light absorption can be enhanced considerably because of the excitations of surface plasmons. Thus, textured metal electrodes may improve many photo-electrochemical processes, such as photo-current, photo-voltaic, and photo-chemical reactions. Here, we demonstrate a new kind of metal electrodes with inverse-opal structures. Photo-current generated by the electrodes is enhanced considerably due to enhanced absorption.

Electronic structures of inverse spinels LiMVO4(M=Ni,Cu) from first principle calculations

李晟

Abstract

We calculate the electronic structure of $LiMVO_4$ (M=Ni,Cu) based on the density functional theory (DFT). We concentrate on establishing the ground states and structures of these inverse spinels. We find the Li/Ni atoms to be randomly distributed as the Li/Cu atoms to be finely ordered on the ground states. Furthermore, we calculate the noncollinear AFM model of $LiCuVO_4$, given the DOS graph and bandstructure, which shows that it will generate a gap near the Fermi level.

Targeting and imaging cancer cells by Folate-decorated ,core-shell characterized quantum dots (QDs) -loaded BSA

孟鹤

Abstract: Folate receptors are up-regulated on a variety of human cancers, including cancers of the breast, ovaries,endometrium, lungs, kidneys, colon, brain, and myeloid cells of hematopoietic origin. This over-expression of folate receptors (FR) on cancer tissues can be exploited to target folate -linked imaging and therapeutic agents specifically to FR-expressing tumors, thereby avoiding uptake by most healthy tissues that express few if any FR.

We are going to develope a new strategy to prepare folate-decorated, core-shell characterized nanoparticles forQuantum dots (QDs) formulation for targeted and sustained imaging for cancer diagnosis at its early stage.Core-shell charactorized QDs and FA are blent for preparing decorated QDs to improve their imaging effects. In vitro cellular uptakes of such QDs are going to be investigated with confocal laser scanning microscopy (CLSM), which may demonstrate much
higher internalization of the folate-decorated QDs by KB cancer cells which are of over-expression of folate receptors.

Induction of membrane hole by pH low-insertion peptide: an atomistic molecular simulation study

邓永华

Abstract: The pH low-insertion peptide(pHLIP) serves as a model system for peptide inserition and folding across a lipid bilayer. Under pH-low environment, it inserts across the bilayer as an α-helix. Recent experimental studies show that it may prove a promising tool for selecive delievery agents for drug therary. However, the mechanism by which the pHLIP influence the bilayer is poorly understood. Here we use alll atomistic molecular dynamics simulation to explore the interaction between the pHLIP and the model membrane bilayer 1-palmitoyl-2-oleoyl-phosphatidylcholine (POPC). The pHLIP rapidly attaches to the surface of the POPC and rests there for a long time. Howerer, if it breaks through the energy barrier of the surface, it rapidly inserts into the bilayer and, surprisingly, it induces the membrane to form a 2-3 ns hole parallel to the inserted PHLIP, across which the water permeates. This hole may permits the the other proteins or small molecules to go across. The pHLIP disrupts the membrane with a permeating hole but it doean't ruins the membrane. This results is importtant to understand the toxiticy of the proteins and demonstrates the possibility of using pHLIP as a new drug molecular cargo, which we believe will be useful in a variety of biochemical and biophysical investigations related to the cell membrane and drug design.

Keywords: pHLIP, membrane protein, hole formation, drug delivery

关于量子绝热近似和绝热近似条件的一些讨论

马利

摘要

近年来，量子绝热计算的提出使得量子计算有了一个新的途径，量子绝热计算的实现依赖于量绝热定理和绝热条件的满足。但是，近几年来有人发现量子绝热条件在理论上是不自洽的，通过实验上也同样证明了传统的量子绝热条件在保证量子绝热演化中是既非充分也非必要的。本工作介绍通过考察传统绝热条件的推导，试图修正得到更加适用的绝热条件。

Preparation of Deeply underdoped $Bi_2Sr_2Ca_2Cu_3O_{10+\delta}$ single crystal

韦佳

Abstract

With elaborate vacuum annealing, we have succeeded in preparation of the underdoped tri-layer cuprate $Bi_2Sr_2Ca_2Cu_3O_{10+\delta}$ (Bi2223) samples with different doping. The Tc reduces from 100 to 18K and the transition width (ΔTc) increases from 2 to 7 K, the sharp real part of the susceptibility as a function of temperature indicated that oxygen distribution is rather homogeneous in our crystals. This improvement makes possible a more complete picture of HTSC phase diagram and is helpful to understand the mechanism of the superconductivity.

Quantum entanglement and fixed-Point bifurcations

Rukuan Wu

In recent years the entanglements of many-body systems have been studied. It has been found that the entanglement of the ground state is maximal at phase transition point in the infinite systems. A QPT means that the ground state changed enormously as a system parameter is varied. In the classical regime, the phase coordinates of the ground state correspond to the stable fixed pointed. If we alter the system parameter, the fixed points may undergo bifurcations. We study the fixed point bifurcations of classical systems corresponding to a quantum many-body system, and find that corresponding to the quantum system the entanglement of the ground states attains the maximum at the bifurcations. It affords a method to find the maximal entangle states of the complex quantum systems.

Structural properties and electronic structures of amorphous HfO_2/Si(001) interface

陈国红

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Using the projector augmented wave method within the generalized gradient approximation, we have performed *ab-initio* molecular dynamics simulations to generate an atomic structure model of amorphous hafnium dioxide (*a*-HfO_2) by a melt-and-quench scheme, and have investigated the structural and electronic properties of *a*-HfO_2 /Si(001)-*c*(2×2) interface. The structure of *a*-HfO_2 sample is analyzed via atomic coordination number and partial pair-radius distribution functions. Our results show the average Hf-O nearest-neighbor distance is 2.06 Å, which is comparable with the Hf-O bond lengths (in the range from 2.04Å ~ to 2.25Å) in monoclinic HfO_2 crystalline, and also indicate the generated sample essentially reflects the experimentally measured structural characteristics of *a*-HfO_2. Most importantly, it is found that the valence band offset of *a*-HfO_2/Si interface is about 2.97eV, and our results suggest that the coordination of Si atoms at interface would significantly affect the electronic properties of interface.

Cooling a mechanical resonator via coupling to a tunable double quantum dot

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We study the cooling of a mechanical resonator (MR) that is capacitively coupled to a double quantum dot (DQD). The MR is cooled by the dynamical backaction induced by the capacitive coupling between the DQD and the MR. The transition between the two dots of the DQD is excited by an a.c. field and afterwards a tunneling event results in the decay of the excited state of the DQD. An important advantage of this system is that both the energy level splitting and the decay rate of the DQD can be well tuned by varying the gate voltage. We find that the steady average occupancy, below unity, of the MR can be achieved by changing both the decay rate of the excited state and the red-detuning between the transition frequency of the DQD and the microwave frequency, in analogy to the laser sideband cooling of an atom or trapped ion in atomic physics. Our results show that the cooling of the MR to the ground state is experimentally implementable. However, the MR can be heated and the steady-state average occupancy becomes infinite when the microwave frequency is larger than the transition frequency of the DQD (blue detuning).

Whispering gallery modes in indium oxide hexagonal microcavities

董红星

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We report on the use of In_2O_3 nanowires with hexagonal cross section as optical whispering gallery resonators. The single-crystal In_2O_3 nanowires were fabricated by an *in situ* thermal oxidation method. Whispering gallery modes (WGMs) in the visible spectral range were directly observed at room temperature. Due to the slight tapering of the nanowires, the energies and orders of the WGMs were modulated when excitations were scanned along the *c*-axis (length) of the nanowires. The experimental results were explained and fitted well with a plane wave interference model and Cauchy dispersion formula for refractive indices.

Temperature-dependent Photoluminescence Spectra of Er-Tm-codoped Al_2O_3 Thin Film

娄昊楠

Er-Tm-codoped Al_2O_3 thin films with different Tm to Er concentration ratios were synthesized by cosputtering from separated Er, Tm, Si, and Al_2O_3 targets. The temperature dependence of photoluminescence (PL) spectra was studied. A flat and broad emission band was achieved in the 1.4-1.7 μm and the observed 1470, 1533 and 1800 nm emission bands were attributed to the transitions of Tm^{3+}: $^3H_4 \rightarrow {}^3F_4$, Er^{3+}: $^4I_{13/2} \rightarrow {}^4I_{15/2}$ and Tm^{3+}: $^3F_4 \rightarrow {}^3H_6$, respectively. The temperature dependence is rather complicated. With increasing measuring temperature, the peak intensity related to Er^{3+} ions increases by a factor of five, while the Tm^{3+} PL intensity at 1800 nm decreases by one order of magnitude. This phenomenon is attributed to a complicated energy transfer (ET) processes involving both Er^{3+} and Tm^{3+} and increase of phonon-assisted ET rate with temperature as well. It should be helpful to fully understand ET processes between Er and Tm and achieve flat and broad emission band at different operating temperatures.

CdTe 量子点在活体细胞中的探测：双光子激发

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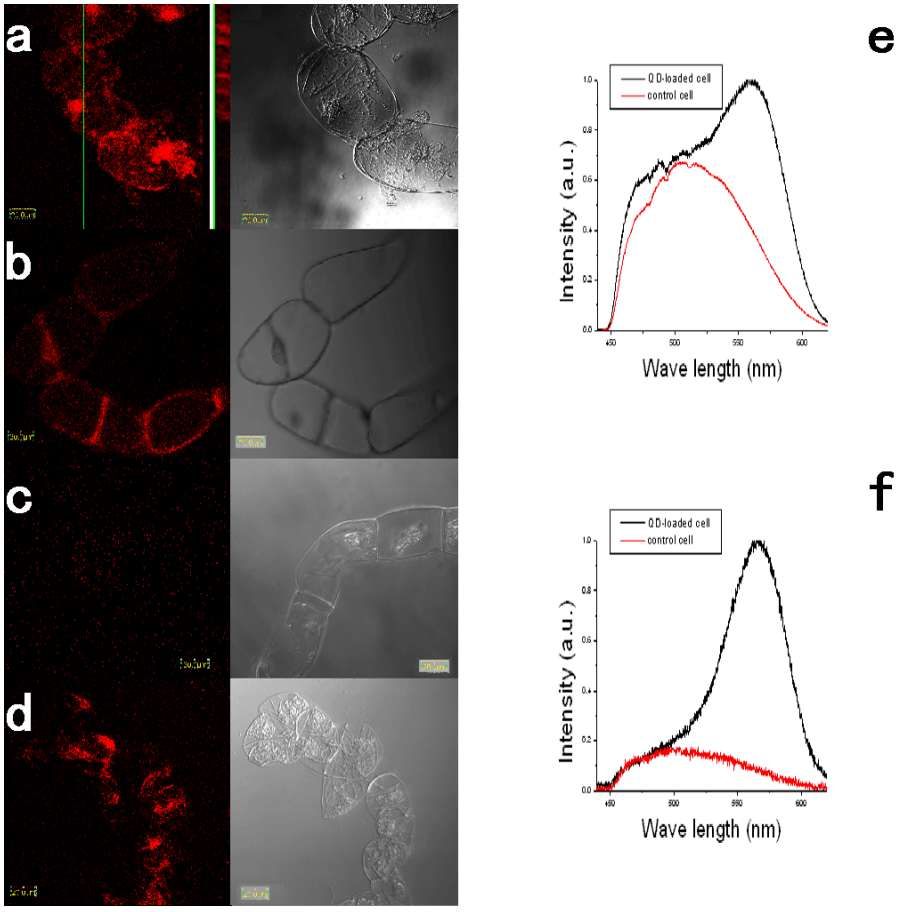
复旦大学物理系 [1]，光科系 [2]

荧光探针开启了细胞探测的新时代。但是，传统的荧光染料存在着激发峰窄发射谱宽且易淬灭的缺陷。而量子点恰能弥补荧光染料的不足，量子点的激发光谱比较宽，发射光谱窄，且对称，通过控制量子点的大小可得到不同的发射波长，实现用同一波长激发获得不同波长的发光，从而解决生物分子的荧光标记。

其次，在生物体的荧光标记测量时，生物分子的自体荧光会带来干扰给实验测量带来困难。本工作要解决的问题就是如何降低生物体自体荧光,得到更好的荧光探针的信号。我们发现使用飞秒激光作为激发源，以量子点为标记物，利用双光子激发做为探测原理，就可以解决遇到的问题。因为生物体自身组分的双光子吸收截面要远远小于探针(CdTe)量子点的双光子吸收截面。



以 Tobacco BY-2 细胞为模型，图左半部分是 Tobacco 细胞在共聚焦荧光显微镜下得的荧光照片。a: 吞噬了量子点的烟草细胞在 405nm(单光子)激光激发下得出来的荧光像；b: 未吞噬量子点的烟草细胞在 405nm 激光激发下得出来的自体荧光像。a 图的荧光像明显比 b 图的亮，是因为量子点在激光的激发下，发出很强

荧光的缘故，但其中包含了细胞的自体荧光。
c: 未吞未噬量子点的烟草细胞在 800nm(双光子)激光激发下得出来的荧光像。d: 吞噬量子点的烟草细胞在 800nm 激光激发下得出来的荧光像。c 图烟草细胞的荧光像基本看不见,因为烟草细胞中发出自体荧光的组分的双光子吸收截面很小。d 图中得到的荧光像则是量子点的荧光信号。

图中右半部分则是对应的荧光光谱，黑色光谱是在吞噬了量子点的烟草细胞中得到的，而红色光谱则是在未吞噬量子点的烟草细胞中得到的。e 图是在 405nm(单光子)激光激发下的发射光谱，由图可见，自体荧光很强，且极大得干扰了探针量子点的信号。f 图是在 800nm(双光子)激光激发下得到的发射光谱，可以看出利用双光子探测的手段，自体荧光的强度被大大削减，从而可以得到更好的探针(量子点)的信号,因为量子点的双光子吸收截面非常大。

结论：量子点在双光子的激发下用于生物标记有很好的优越性，能降低生物体的自体荧光得到可靠的标记信号，在生物标记测量中有广泛的应用前景。

Bi/Cu(111) 表面合金未占据态的 Rashba 分裂

于平

我们利用双光子光电子能谱，第一次在实验上观测到了 Bi/Cu(111)表面合金在高于费米能级 1.3eV 的能量处具有未占据的自旋劈裂能态。这些能态可以用 Rashba 模型进行很好的拟合，从拟合结果我们可以得到 Bi/Cu(111)表面合金未占据态的 Rashba 分裂的大小和有效质量等。

Quasinormal modes of black holes absorbing dark energy

贺喜

Abstract:

We study perturbations of black holes absorbing dark energy. Due to the accretion of dark energy, the black hole mass changes. We observe distinct perturbation behaviors for absorption of different forms of dark energy onto the black holes. This provides the possibility of extracting information whether dark energy lies above or below the cosmological constant boundary $w=-1$. In particular, we find in the late time tail analysis that, differently from the other dark energy models, the accretion of phantom energy exhibits a growing mode in the perturbation tail. The instability behavior found in this work is consistent with the Big Rip scenario, in which all of the bound objects are torn apart with the presence of the phantom dark energy.

暴涨宇宙模型中温度对能谱的效应

尹少禹

Temperature effect on the power spectrum in inflation

Shaoyu Yin

Abstract

We examine the effect of the thermal vacuum on the power spectrum of inflation by using the thermal field dynamics. We find that the thermal effect influences the CMB anisotropy at large length scale. After removing the divergence by using the holographic cutoff, we observe that the thermal vacuum explains well the observational CMB result at low multipoles. This shows that the temperature dependent factor should be considered in the study of power spectrum in inflation, especially at large length scale.

Symmetry breaking in SSH model

葛力

Abstract

The Su-Schrieffer-Heeger (SSH) model describes a one-dimensional crystal with strong electron-phonon coupling. The motion of the lattice in this model can be viewed as a trajectory in N-dimensional space, with N as the number of lattice units. Because of the strong electron-phonon coupling, the Hessian matrix corresponding to the trajectory is time-dependent. It is found that in some trajectories there exist so-called critical points, before which all the eigenvalues of the Hessian matrix are positive, and after which several eigenvalues are changed to negative. Thus, if the lattice moves along these trajectories, symmetry breaking will occur, where symmetry means $u_n = u_{-n}$, with u_n as the displacement of the n^{th} lattice unit. We present the criterion for symmetry breaking and verify it numerically, the consequence of symmetry breaking is discussed also.

外禀机制对反常霍尔效应贡献的研究

田源，金晓峰
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在典型的磁性材料铁中，通过前几年的研究，证实了内禀机制在室温下占主导地位。通过变化薄膜的温度和厚度，我们能够从实验结果分离出外禀机制的贡献，并通过实验研究了其具体的来源（界面/杂质原子），具体的机制（skew scattering/side-jump）以及其随温度 scale 的规律。研究结果对合金中反常霍尔效应的来源有重要的指导意义。同时也对研究来源于外禀机制的自旋霍尔效应有启发作用。

Effects of dark sectors' mutual interaction on the growth of structures

何建华

摘要：
We present a general formalism to study the growth of dark matter perturbations when dark energy perturbations and interactions between dark sectors are present. We show that dynamical stability of the growth of structure depends on the type of coupling between dark sectors. By taking the appropriate coupling to ensure the stable growth of structure, we observe that the effect of the dark sectors' interaction overwhelms that of dark energy perturbation on the growth function of dark matter perturbation. Due to the influence of the interaction, the growth index can differ from the value without interaction by an amount within the observational sensibility, which provides a possibility to disclose the interaction between dark sectors through future observations on the growth of large structure.

High-Q Unidirectional Emission Property of Novel Axial Symmetric Asymptotic Microcavities

涂鑫
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In these years, people have paid much attention to optical microcavities for their applications in microlasers, chemical and biological sensors and optical communication. Circular-shaped microcavities can support high quality (Q) whispering-gallery modes (WGMs) due to their closed total internal reflection, but special methods are necessary to couple the well-trapped light out from the cavities (waveguide and tapered fiber coupling are examples). To improve the efficiency of energy extraction, various types of deformed cavity structures were devised with the compromise of drastically decreased Q value. A recent work on limacon cavity revealed that high-Q unidirectional emission was still possible, however, the emission divergence was far from satisfactory, also the mode pattern was chaotic-like. Another approach to achieve directional emission is using coupled microcavities (such as coupled disks or rings). The coupling also enhances some mode Q factors while degrading the others to lower the threshold of lasing and select a certain (or even single) lasing mode.

In this paper, we show our calculation results on a novel deformed microcavity structure, namely axial symmetric asymptotic microcavity (ASAM) using two-dimensional(2-D) finite difference time domain (FDTD) method. We found that this cavity can support clearly high-Q ($Q>10^4$) distorted WGMs and directional emission. To further improve the far field pattern and artificially control the Q-factor, two size-mismatched ASAMs were coupled, by adjusting the inter-cavity distance and the size of the coupled cavity, and enhanced high-Q supermodes with unidirectional emission were obtained with a divergence of 19^o.

Topological Quantum Phase Transition in 1D Spin Chain

臧佳栋

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Topological quantum phase transition (TQPT) is a new class of phenomenon in condensed matter physics beyond the Landau-Ginzburg regime. In this work, we construct a model Hamiltonian with one variational parameter α in 1-dimensional spin-2 chain. The edge state is boson-like for $\alpha = 0$, while fermion-like for $\alpha = 1$. Due to this distinction, topological quantum phase transition is predicted, and is addressed by DMRG and MPS calculation. To our knowledge, this is the first example of TQPT in spin system.

Inducing a Magnetic Monopole withTopological Surface States

臧佳栋
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Existence of the magnetic monopole is compatible with the fundamental laws of nature; however, this elusive particle has yet to be detected experimentally. We show theoretically that an electric charge near a topological surface state induces an image magnetic monopole charge due to the topological magneto-electric effect. The magnetic field generated by the image magnetic monopole may be experimentally measured, and the inverse square law of the field dependence can be determined quantitatively. We propose that this effect can be used to experimentally realize a gas of quantum particles carrying fractional statistics, consisting of the bound states of the electric charge and the image magnetic monopole charge.

Anomalous magneto-optical Kerr effect in perpendicularly magnetized Co/Pt films on two-dimensional colloidal crystals

刘尊

摘要：We have studied the magneto-optical Kerr effect and optical reflectance of perpendicular magnetized Co/Pt films on self-assembly two-dimensional polystyrene spheres. It is shown that the magneto-optical and the reflectance spectra are correlated to each other. Calculations have shown that the magneto-optical Kerr rotation and the Kerr ellipticity spectra are governed by the resonant coupling of light to the excitations of surface Plasmon polaritons and modified by the sphere diameters. These effects lead to the possibility of developing new magnetoplasmonic nanosensors.

Magnetization reversal mechanism of perpendicularly exchange-coupled composite $L1_0$-FePt/CoCrPt bilayers

徐振

摘要：

Magnetization reversal mechanism in perpendicularly exchange-coupled composite hard/soft $L1_0$-FePt/CoCrPt bilayers with different soft layer thickness has been studied using magnetometry and magneto-transport measurements. For thin soft layers, the magnetization reversal process can be described by the rigid model. For thick soft layers, a different magnetization reversal process is observed which consists of three stages. An exchange-spring spin structure is first formed from the positive saturation magnetic field to small negative magnetic field. In the second stage, a Neel wall is driven and squeezed. In the last stage, multiple domain structure is formed laterally to reduce the dipolar interaction and the magnetization reversal is accomplished by the pinned domain wall motion in the hard layer.

Single laser induced dynamic magnetization reversal mechanism of perpendicularly magnetized $L1_0$ FePt films

徐振

摘要：

Single laser pulse induced dynamic coercivity cannot be measured rigorously by the conventional time-resolved magneto-optical Kerr effect technique because the irreversible deviation of the transient magnetization is accumulated. In order to remove the accumulation effect, the alternating magnetic field is employed and synchronized with the femtosecond laser pulse. Since the sample is reset before each single laser pulse, the accumulation effect of the irreversible deviation of the transient magnetization is removed. For perpendicularly magnetized $L1_0$ FePt films, the dynamic magnetization reversal process is accomplished by the nucleation of reversed domains and the pinned domain wall motion.

巨电流变液物理模型研究

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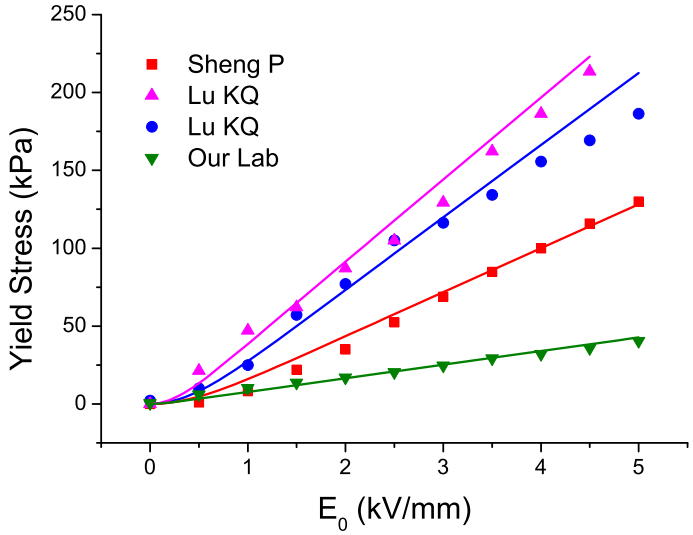
摘要

巨电流变液材料都是使用表面修饰的材料，相关研究认为材料表面包裹的材料对体系的电流变液效应有极为重要的作用[1]。我们采用了等效表面偶极子的模型把这种表面材料的影响引入进来[2]，这样就突破了传统电流变液所能达到的理论极限。我们发现表面偶极子在电场下的转向极化及其与局域电场的相互作用是产生巨电流变液的主要原因。我们的理论能很好地解释实验现象，而且给出了在这个新的模型下的理论极限。进一步，我们的模型也能用来设计离子包裹的电流变液等新型材料。



图：用极化转向模型拟合实验的结果

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资源分配中“看不见的手”

The “Invisible Hand” in Resource Allocation

王玮

230 多年前，亚当·斯密在《国富论》中指出：自由市场表面看似混乱而毫无拘束，实际上却是由一双所谓的“看不见的手”（invisible hand）所指引，引导市场生产出正确的产品数量和种类。我们相信，这只“看不见的手”不仅仅存在于经济市场中，也广泛存在于各种社会或生物系统中。这些由大量相互作用的个体组成的系统，对环境具有高度的适应能力，可被视作复杂适应性系统。这些系统中的个体以自利为原则决策各自的行为，在对系统内分布不均的有限资源的竞争中导致系统整体上有效的（合理的，均衡的）或非有效的资源配置。实际生活中的资源分配现象往往面临资源的非均匀分布，例如：公司及其竞争对手选择进出不同大小的市场，司机们选择不同的交通路线，赌马时人们以不同的赔率投注赢得奖金，等等。通常认为，在普遍存在的“看不见的手” 的引导下，系统资源的配置最终可以达到一种理想的均衡状态，即有效配置状态。然而，现实当中这种所谓“看不见的手”有时也会失效，即所谓的“市场失灵”现象。

在最近的研究中，我们聚焦于非均匀分布的资源分配问题。首先，我们设计并组织了一系列行为经济学的实验。我们发现即使完全没有实验参加者之间的直接交涉，也完全没有外部力量对参加者进行的协调，实验中的虚拟资源的配置还是达到了有效状态。也就是说，我们找到了“看不见的手”存在的证据。然后，我们在“少数派博弈”（Minority Game）模型的基础上构建了“市场导向的资源分配博弈”（Market-Directed Resource Allocation Game，MDRAG）模型。新模型很好地解释了实验结果。与此同时，通过 MDRAG 模拟我们提出了“看不见的手”作用的一种可能的微观机制，并且发现了使其发挥调节功效的充分条件：第一（也是最重要的）：资源竞争的参与者所持的竞争战略必须具备足够的多样性，对分布于各处的资源的偏好能随环境演化而自动调整；第二：市场参与者的决策能力必须与环境的复杂程度相匹配。更为有趣的是，在 MDRAG 的模拟结果中我们发现了多个相变过程，而正是在这些相变的临界点附近“看不见的手”的调节功效可以被发挥到极致，此时的市场呈现出资源配置有效、配置波动稳定、波动方向不可预测的状态。

The “Invisible Hand” in Resource Allocation

王玮

More than 230 years ago, Adam Smith expounds in *The Wealth of Nations* that the free market, while appearing chaotic and unrestrained, is actually guided to produce the right amount and variety of goods by a so-called "invisible hand". It is believed that the generalized "invisible hand" exists not only in economic markets, but also in many biological and social systems. Involving a large number of interacting agents, all these systems can be regarded as complex adaptive systems (CAS), because they are characterized by a high degree of adaptive capacities to the changing environment. Self-serving agents in these CAS compete against others for the limited and biasedly distributed resource by conducting strategic behaviors, which could globally result in some kinds of efficient (reasonable, balanced) or inefficient resource allocation. Examples of such phenomena include companies competing among markets of different sizes, drivers selecting different traffic routes, people betting on horse racing with the odds, etc. Generally speaking, the allocation of the resources could reach an idealized balanced state, that is, the efficient allocation state, under the directing power of the “invisible hand”. In practice, however, sometimes it will fail and cause the so-called “market failure” phenomenon.

In our recent study, we focused on the biasedly distributed resource allocation problem. First, we designed and conducted a series of behavioral economic experiments. We found that the allocation of a virtual resource could reach the efficient state in these experiments, even if direct negotiations among the participants, as well as the external instructions which might create collaboration among them, were completely forbidden. In other words, we demonstrated the existence of the “invisible hand”. Next, based on the minority game (MG), we constructed a model called market-directed resource allocation game (MDRAG). The new model can explain what we found in our experiments. In the mean time, through a large number of the MDRAG simulations, we are able to put forward a possible mechanism for the “invisible hand”. Furthermore, the sufficient conditions under which the “invisible hand” could fully play its role are found as the following: First and most importantly, the competing strategies of the participants of the resource allocation market must have heterogeneous and adjustable preferences for the biasedly distributed resources; second, the decision making capacities of the participants must match the complexity of the environment. A more interesting discovery is related to a number of phase transitions found in the MDRAG simulations. Around the critical region of these phase transitions, the directing power of the “invisible hand” can be released completely, which could lead to an efficient, stable and unpredictable market.

Two qubits entanglement dynamics in common environment

李睿

Abstract:

Two qubits’entanglement can be used as a main resource in quantum computation and quantum information processing. While qubits systems evitable interact with external environment, thus qubits’entanglement will dissipate because of environment noise. How to protect entanglement against environment noise has been a main project. We calculate the entanglement dynamics via master equation approach with markovian white noise.

Origin of the co-dopant induced enhancement of ferromagnetism in (Zn,Mn)O

朱岩

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Abstract

Using the density functional calculations, we elucidate the mechanism of co-dopant induced enhancement of ferromagnetism of (Zn,Mn)O. Li and Cu atoms tends to segregate toward Mn atoms and strongly promote the ferromagnetic coupling via either RKKY or superexchange interaction. The hole states introduced by either Li or Cu are rather delocalized and they are efficient in mediating magnetic ordering. These findings shed new light for the design of dilute magnetic semiconductors with co-dopants for spintronic applications.

Improved transfer matrix method without numerical instability

殷慧琼
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A new improved transfer matrix method (TMM) is presented. It is shown that the method not only overcomes the numerical instability found in the original TMM, but also greatly improves the scalability of computation. The new improved TMM has no extra cost of computing time as the length of homogeneous scattering region becomes large. The comparison between the scattering matrix method(SMM) and our new TMM is given. It clearly shows that our new method is much faster than SMM.

The conductance mechanism of GeSi quantum rings studied by SPM

张生利

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Abstract

Topography and electrical properties of individual self-assembled GeSi quantum rings (QRs) grown by molecular beam epitaxy were investigated by conductive atomic force microscopy at room temperature. And also the composition distribution of the QRs was investigated by combining the AFM with selective wet chemical etching. The current image captured simultaneously with the topography reveals that the ring part of the individual QRs is more conductance than the QRs center. But the selective chemical etching results show that the Ge composition distributes mainly at the center of QRs. It is well known that the conductance of germanium is several magnitude higher than silicon. That's very difficult to understand this conflict by common sense. A possible mechanism for explanation is supposed by considering the quantum structure, and both electrostatic force microscopy and scanning capacitance microscopy were used to support the possible mechanism.

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Research on the coupling effect of localized surface plasmons in nanoparticle chains

席斌

摘要

A study of the localized surface plasmon resonance in different gold nanoparticle chains is presented. A tight-binding method combined with the full-wave simulation not only allows us to predict the resonance frequencies in chains consist of periodically arranged nanoparticles, but it also allows us to quantitively define the coupling effect of localized surface plasmons on nanoparticles.

Directive emissions of antennas on metamaterial ground planes: Role of anomalous re°ection phases

丁鲲

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E±ciency and radiation pattern are two important characteristics of antenna radiations[1]. Recently, there has been much interest to employ metamaterials to control the radiation behaviors of antennas[2{5]. For example, directive emission can be achieved by simply putting a point source inside a metamaterial with zero refractive index[2], or inside a subwavelength cavity formed by speci¯cally designed metamaterials[3]. In this work, we study the radiation properties of antennas put on ground planes formed by metamaterials, aiming to ¯nd the conditions under which the

antenna emissions could be highly directive. We ¯rst applied a dyadic Green's function approach to analytically study the radiation properties of antennas put perpendicular or parallel to the ground plane, and found that the metamaterial ground plane should possess certain re°ection phase properties in order to support directive emissions. We then employed ¯nite-di®erence-time-domain (FDTD) simulations to successfully design realistic metamaterials structures as appropriate ground planes to support directive emissions for both orientations of antennas. Microwave experiments, in good agreements with FDTD simulations, were performed to verify the theoretical predictions[6].

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An alternative way to obtain dark energy from f(R) theory

Chang Feng

Abstract: Differing from the ordinary scalar-tensor theory, the effect of dark energy is accounted for what the curved space and time acting. We combine the new 307 Union supernova Ia samples, the shift parameter of the Cosmic Microwave Background(CMB) given by the three-year Wilkinson Microwave Anisotropy Probe observations(WMAP), the baryon acoustic oscillation(BAO) measurement from the Sloan Digital Sky Survey(SDSS) and age estimates of 35 galaxies, as well as the X-rays of galaxies, to constrain the minimum-coupling f(R) theory. The character of the effective dark energy is analyzed. Moreover, the non-minimum coupling theory is also discussed theoretically.

Transient photovoltage measurement applied to exciton dissociation research

武博

Abstract: With the cost of fossil fuels rising, attention is once again turning to Organic Solar Cells, which can produce electricity much more cheaply than conventional silicon based solar cells. Exciton dissociation is a key process in OSC, giving rise to many related research. In this work, I introduce transient photovoltage measurement into this process, in order to find out the direction of dissociation at the interface between organic layer and electrode.

Longitudinal-elliptical-polarized EM waves in off-diagonal chiral media

王伟华

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Abstract

We study a chiral medium [1] with constitution relation $\vec{B} = \mu\vec{H} + \alpha\vec{E}, \vec{D} = \varepsilon\vec{E} + \beta\vec{H}$ in which the magnetoelectric elements α, β are off-diagonal matrices [2]. The propagations of electromagnetic (EM) wave inside such a medium exhibit many fantastic properties. We find that, under certain conditions, the electric field of a particular EM wave mode becomes longitudinally elliptical-polarized in the propagating direction and the Poynting vector has a component that is perpendicular to the plane of incidence. We present a phase diagram to show the optimal parameters for the chiral medium to exhibit such unusual wave polarization behaviors, and illustrate such an extraordinary effect by designing a double-refraction experiment at the air/medium interface. We finally perform FDTD simulations on realistic structures to verify such unusual wave phenomena.

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Multifrequency cloak with multi-shell by using transformation medium

高勇

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Abstract

We theoretically investigate multifrequency cloak based on multi-shell by using transformation medium. As for each shell, we use the Maxwell-Garnett theory and the spectral representation theory to design the permittivity profile for the transverse magnetic (TM) wave. The plasma frequencies of the metals used in the inner (B) and outer (C) shells must satisfy $\omega_1 < \omega_{pc} < \omega_2 < \omega_{pb}$. In such case, incident electromagnetic wave of lower frequency ω_1 will be distorted only by the outer shell C without entering the inner shell B to achieve invisibility. However, at the higher operating frequency ω_2, the outer shell C is transparent by choosing the materials appropriately, and the incident electromagnetic wave will be distorted only by the inner shell B to achieve invisibility. So, the multi-shell cloak can work simultaneously on two different optical frequencies. Furthermore, we use the anisotropic differential effective dipole theory (ADEDT) to evaluate the efficiency of the cylindrical cloak.

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Optical response of strongly coupled metal nanoparticles

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abstract

The optical responses of coupled metal nanoparticles are studied by using the image method of dipoles[1]. For two unequal nanoparticles, the small particles are revealed to have an evident shift of surface plasmon frequencies, which depend on the mutual interaction between the two particles. Our results exhibit that the plasmon resonant frequency of a small particle can be readily tuned by using a big particle nearby, due to the relatively strong electromagnetic coupling.

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The conductance of alkane chains: the influence of anchoring groups and their binding sites

盛威

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By means of first-principles calculation, we investigate the effects on electron transport properties of molecular junctions due to different electrode-molecule contact details. The model system chosen is the N-alkanes sandwiched between two gold electrodes with three different terminal groups (ad-sorption strength) and their bonding sites. The calculated low-bias conductance of each junction show two sets of different values for the four bonding sites considered, which has also been reported in some recent experiments. We found that this evident phenomena will persists for dicarboxylic-acid-terminated alkanes but not for dithiol and diamine-terminated alkanes when the bias higher up to the nonlinear region of the I-V curve. The origin of this results is explained quantitatively in terms of the delocalization of molecular orbital near the fermi level and the coupling strength for different groups to the gold electrodes. We also found that the conductance value of the junction decrease exponentially with the molecular length, the obtained prefactor of the exponential decay function (which reflects the contact resistance) shows a significant dependence on the anchoring groups while the decay constant varied a little during the shift of anchoring groups and their bonding sites.

Microparticle separation by dielectrophoresis and hydrodynamic forces

赵晓雪

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Abstract

We propose a novel microchannel system for microparticle separations. Based on dielectrophoresis effect generated by a series of microelectrodes, microparticles with different dielectric constants will incline to different tracks. Then with the implement of hydrodynamic forces by continuous flows, microparticles are further separated into different channels. We investigate simulatively the dynamic behaviors of mixed microparticles in this system, based on the theories of dielectrophoresis and Langevin dynamics. It is found that a proper configuration of microelectrodes can make very high efficient separations. We further investigate the probability of successful separation, under different system parameters. This work has relevance to the Lab-on-a-chip systems, which are widely applied in biological and chemical experiments and industry.

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Hole trapping induced I-V staircase in individual GeSi quantum dots studied by Conductive AFM

张翼飞
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Interest in zero-dimensional quantum dots has been intense which lies mostly in their technological potential as well as their fundamental electrical properties. We have investigated the electrical properties of individual self-assembled GeSi quantum dots grown on silicon substrates using Conductive Atomic Force Microscope at room temperature. Current staircases are observed when measuring current-voltage dependences on individual quantum dots. The origin of this phenomenon is supposed to be hole trapping in the potential well formed by the quantum dot sandwiched between the native oxide and the bottom Si substrate.

Size Dependence of Electric Properties of Individual SiGe Quantum Dots

ZHAO, Shihua

The electric properties of individual self-assembled quantum dots (QDs) are essentially important for applications as well as fundamental studies. Here the electric properties of individual GeSi QDs are studied by conductive atomic force microscopy (CAFM). The dependence of current-voltage (I-V) characteristics on the quantum dot's size is studied, and the quantum effects of GeSi QDs are obtained. Also both the bias voltage (BV) dependence and force (F) dependence of conductance properties are measured on QDs with different size, and a possible mechanism is suggested in the results.

陈强

My important work is to investigate nonlinear optical properties of carbon nanotube composites by using Z-scan method. At present, I pay attention to a new type of hybrid carbon nanotubes, multi-wall carbon nanotubes coated with metal sulfates.

The new type of hybrid carbon nanotubes, multi-wall carbon nanotubes coated with metal sulfates, is synthesized. The optical limiting characteristics of pure multi-walled carbon nanotubes(MWCNTs) and MWCNTs coated with metal sulfate (MS) by a new fabrication method are studied at wavelength of 527 nm. Fluence-dependent transmission and Z-scan measurements using 100 ns pulses show that by coating with MS MWCNTs suspensions, samples exhibit a stronger optical nonlinearity than pure MWNTs. This new type of hybrid carbon nanotubes with coated metal sulfates on the sidewall may have potential applications in field emitters or optoelectronic devices.

Guiding Electromagnetic Energy below the Diffraction Limit with Dielectric Particle Arrays

杜骏杰

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We demonstrate that electromagnetic energy can be efficiently guided along a single chain, around a corner, and split at forked structures below the diffraction limit with the use of appropriate dielectric particle arrays. The fields are confined to a region with the transverse width less than half of the guided wavelength. Our results give an explicit demonstration for the first time that the dielectric based subwavelength photonic circuit is achievable, providing an alternative to the surface‐plasmon‐based metallic counterpart.

PtSi/Si interface structure and its dipole induced SBH modulation effect

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We present a calculation of the Schottky-barrier height(SBH) at the Si(001) / PtSi(001) interface , based on first-principles calculations. The p-type Schottky-barrier height of 0.207 eV is found in good agreement with available experiments. We further studies the SBH modulation effect induced by ion implantation of Ga and P near the interface. The SBH modulation effect between two materials is caused by changing the interface dipole directions and values. The direction change of SBH is determined by the type of the dopant. The changed value of SBH is found to has a linear relationship with the interface dipolmoment.

Acoustic superscatterers and external acoustic cloaks using metamaterials

刘斌
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Using acoustic metamaterials, we design and investigate two kinds of novel acoustic devices: two-dimensional acoustic superscatterers and two-dimensional novel acoustic cloak that can cloak "external" objects. In acoustic superscatterers, metamaterial layers are used to enhance their acoustic scattering cross section substantially. In our design of novel aoustic cloak, the cloaked objects can be placed outside the cloak, conquering the drawback of existing designs, namely the cloaked objects have to be “deafened”, by allowing receival of incoming waves by the cloaked objects. The crucial material parameters of the metametarial layers are deduced by coordinate transformation method, and the whole designs are verified by finite element simulations.

First-principles study of vacancies in hybrid BN zigzag nanoribbons

潘燕飞

ABSTRACT

We study the magnetism of hybrid boron nitride zigzag nanoribbons with B and N vancancies, based on the first principles. Our calculations predict the spingapless semiconductor configurations. The hybrid BN zigzag nanoribbons show spin-polarized states well localized at the atoms near to both B and N vacancies, except when the distance between the nearest N vancancies is very small. The spin splitting energe increasing while the distance between the nearest vacancies increasing. We show that the high spin state with magnetic moment of $1\mu_B$ at each N vacancy, while $3\mu_B$ at each B vacancy. By changing the the distance between the nearest vacancies, present metallic --->spingapless semiconducting --->semiconducting transitisions.

Analytically Study of BCS-BEC Crossover with Diagram Method

Siqin Cao

Abstract: Though great achievements have been made by using diagram method in BCS and BCS-BEC Crossover, still there're some serious problems. Since the diagram method may fail in coherent systems, we re-deduced the method*;* and with the Boson-Fermion model, we obtain the partition function, the critic temperature and the fermion's particle energy of the BCS-BEC crossover. Finally, we calculate the gap energy in both BCS and BCS-BEC crossover, and propose a possible calculation for the pseudo-gap.

A preliminary analysis of the energy transfer between the dark sectors of the Universe

Jia Zhou

Abstract

We study the mutual interaction between the dark sectors (dark matter and dark energy) of the Universe by resorting to the extended thermodynamics of irreversible processes and constrain the former with supernova type Ia data. As a byproduct, the present dark matter temperature results not extremely small and can meet the independent estimate of the temperature of the gas of sterile neutrinos.

Anomalous Hall effect in NiCu alloys

李禹帆

Temperature dependent Hall effect and resistivity has been investigated in Ni-Cu thin films in a wide composition range, covering the ferromagnetic-paramagnetic critical point. The NiCu alloys in the paramagnetic region show clear anomalous Hall effect at low temperature, which is a strong evidence of the existence of local moments. The result also shows that the extrinsic contribution of AHE decreases with temperature.

A hidden conductance path of nanosized Schottky contacts between ErSi2 nanoislands and Si(001)

宋君强

J. Q. Song, T. Ding, J. Li and Q. Cai

Metal-semiconductor (MS) contacts are an essential part of virtually all semiconductor electronic and optoelectronic devices. Recently there has been great interest in the preparation and characterizations of nanometer–sized Schottky contacts due to their importance in nanoscale electronic and optoelectronic device applications. For macroscale Schottky diodes, transport properties of carriers can be explained well by thermionic emission (TE) theory or diffusion theory. Recent studies showed when the size of Schottky diodes scaled down to nanometer scale, some unique characteristics were displayed. For example, current density through MS interface was much larger than that of macroscopic one, and current density depended on the size of MS interface, and so on. However, the transport mechanisms of carriers for the nanosized MS contacts are not clear at the present. In our study electrical transport property of nanometer sized Schottky diodes formed by epitaxial, $ErSi_2$ nanoislands on p-Si(001) are *in situ* measured by touching the tip of a scanning tunneling microscope to the nanoislands. It is found that the current through nanoislands is sensitive to the surface gas absorption and the conductance of the nanocontacts decreases with the increase of the absorption coverage of oxygen on the sample surface. Our analysis indicates that in additional to the conduction path perpendicular to the MS interface between ErSi2 islands and Si substrate, there is an additional, hidden conduction path – surface conduction path, because the former is not sensitive to the surface absorption. Our experimental results firstly show that the surface conduction dominates for the epitaxial metallic nanocontacts on Si surface.

“Polar Molecule Dominated Electrorheological Effect Based on Different Particle Milling Time”

伍秀峰

Abstract

We have investigated rheological properties of polar-molecule dominated electrorheological (PMER) fluids, including yield stress, shear stress and molecule amount effect. The particles we use are of different milling time, which can indicate the extent of mechanical abrasion of the particles. It’s found that doping additional polar molecules can be a solvent against abrasion, with different contributions to yield stresses in different volume fractions. And we calculated the number of polar molecules by using the most useful additional material amount. On the other hand, we found that the pure viscosity decreases slowly with shear rate and sometimes has a peak, while ER effect stress decreases rapidly. And we proposed some solutions about it.

1

Test of the Cosmic Censorship Conjecture

Zhiqin Shi

Abstract

The Cosmic Censorship Conjecture plays a fundamental role in black hole physics. It asserts that space-time singularities must be encompassed by the event horizon of a black hole. We study a nearly extreme 3D Charged dilaton black hole (CDBH), consider the case that massless Dirac fields absorbed into it. We calculate the absorption coefficient of the fields, and test whether the Cosmic Censorship Conjecture still hold.

Fabrication of Ge quantum dot circle on masked Si substrate

蔡其佳

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Abstract

A novel circularity placement structure of germanium quantum dots has been fabricated by combining techniques including electron beam lithography, wet etching solution and molecular beam epitaxy. It was observed that both pattern and growth parameters affect the morphology of quantum dot molecular. The experimental result indicates the possibilities to investigate properties of quantum dot molecular and single quantum dot.

Keywords:

A1. Low dimensional structures

A1. Atomic force microscopy

A3. Molecular beam epitaxy

B2. Semiconducting germanium

PACS: 81.07.Ta, 85.40.Hp, 81.15.Hi, 68.37.Ps, 68.37.Hk

Study on nonlinear optical properties and ultrafast dynamics

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# of a new blue-light emitting polymer

王耀川

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Abstract:

The materials with large two-photon absorption (TPA) are of great interest in many high-technology applications. In this paper, the nonlinear optical properties and the excited state dynamics of a new blue-light emitting polymer poly[5-(diphenylamino)-1,3-phenylenevinylene] (**Yu1**) were studied, together with those of its starting material 5-(N,N-diphenylamino)benzene-1,3-dicarbaldehyde (**Yu0**). In comparison to the monomer **Yu0**, the TPA property of **Yu1** was found to be significantly enhanced upon polymerization due to the highly delocalized aromatic π-electron conjugated structure. The TPA cross section of **Yu1** (per repeating unit) is about 10 times larger than that of **Yu0**. One-color and two-colour femtosecond pump-probe experiments were used to investigate the excited state dynamics of the two materials. The investigation of the ultrafast dynamics demonstrates the different relaxation processes happened in **Yu0** and **Yu1** samples. From 400 nm one-color pump-probe experiment of the polymer **Yu1**, distinct optical anisotropy was observed. The fast component observed in parallel polarization configuration of **Yu1** disappears in the perpendicular configuration due to the high orientation of exciton migration. The lifetimes of slow process which is assigned to exciton recombination process with fluorescence emission were determined to be 311 ps and 211 ps for **Yu0** and **Yu1**, respectively. The nonlinear optical property study and the ultrafast dynamics results

really reflect an enhanced effect caused by the polymerization of the monomer. Our study also reveals that the polymer **Yu1** may have promising applications in photonics fields, such as two photon imaging, optical limiting and/or PLED.

Unusual Doping Dependence of the Electronic Structure and Coexistence of Spin-Density-Wave and Superconductor Phases in Single Crystalline Sr1-xKxFe2As2

张焱

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The nature of the spin-density wave (SDW) and its relation with superconductivity are crucial issues in the newly discovered iron-pnictide superconductors. Particularly, it is unclear whether the Superconducting phase and SDW are truly exclusive from each other.

We report angle resolved photoemission spectroscopy (ARPES) measurements of Sr1-xKxFe2As2 (x = 0, 0.1, 0.18), single crystals[1]. We show with systematic data that the band splitting is a sign of the SDW on the electronic structure, and it occurs in Sr1-xKxFe2As2, with descending onset temperatures and amplitudes for x = 0, 0.1, 0.18. Since Sr0.82K0.18Fe2As2 has a superconducting transition temperature (Tc) of 25 K, we prove that superconductivity and the SDW indeed coexist even for single crystals, which sheds new light on the interplay of superconductivity and magnetism in iron-pnictide superconductors. Moreover, the unusual doping dependence of the splitting further highlights its complexity and correlated nature, providing new clues for sorting out its mechanism.

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周慧

Motivation： In recent years, there has been a great deal of research work on chalcohalide and chalcogenide glasses due to their unique properties. These glasses have shown themselves to possess large third-order nonlinear optical susceptibility $\chi^{(3)}$ and are potential candidate materials for all optical switching devices. The ultrafast dynamic response of these glasses excited by ultrashort laser pulses has not been attracted much attention.

Abstract: Three series of chalcohalide and chalcogenide glasses (Series A: $0.56GeS_2$-$0.24Ga_2S_3$-0.2KCl,$0.56GeS_2$-$0.24Ga_2S_3$-0.2KBr;SeriesB:$0.56GeS_2$-$0.24Ga_2S_3$-0.2KBr added Ag ion with the concentration of 1×10^{17} ions/cm^2, 2×10^{17} ions/cm^2,respectively;SeriesC:$0.76GeS_2$-$0.19Ga_2S_3$-0.05CdS,$0.68GeS_2$-$0.17Ga_2S_3$-0.15CdS.) were prepared by well-established melt-quenching technique. The ultrafast decay properties of these samples were investigated by using time-resolved fs pump-probe technique. In 800nm one-color pump-probe experiment for three series samples, when the pump power is high enough, the energy relaxation process would include two decay components: a fast component and a slow component. Time constants of the fast component of these glasses are in the order of subpicoseconds, while time constant of slow component is ten to hundreds picoseconds. Two-color pump-probe experiment (with 400nm pump and 800nm probe) and 800nm time-resolved optical Kerr effect (OKE) experiment have also been carried out. The ultrafast response and large third-order optical nonlinear susceptibility, in addition to their wide transparent region and good thermal stability, indicate that these glasses are potential candidate materials for all optical switching devices.

在GeSi量子点上低温生长Si覆盖层中的面缺陷

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摘要

在实际器件应用中，Ge/Si 量子点往往需要被掩埋在 Si 材料中。这一方面可以钝化量子点表面，更好地利用量子点自身的物理特性制作新型光电子器件；另一方面利用量子点形成应变 Si 层，提高 Si 材料的迁移率，制成新型微电子器件。如果 Si 覆盖层在高温下生长，被掩埋量子点的形貌和组分将发生显著的变化，从而量子点的物理性质以及周围的应变 Si 的特性也随着发生明显变化。这不是人们所希望的。降低 Si 覆盖层的生长温度，可以使得被掩埋量子点的形貌和组分保持不变。然而低温生长的 Si 覆盖层的晶体质量尤其是随着覆盖层厚度的变化很少被人们关注。这对于利用量子点周围应变 Si 制作器件而言是一个十分重要的问题。本工作利用透射电子显微术(TEM)研究了在 GeSi/Si(001)量子点上低温生长的 Si 覆盖层的晶体质量及其随覆盖层厚度的变化。

研究结果表明，在温度300 ℃下，覆盖Si层后量子点的形貌和组分保持不变，然而当Si覆盖层厚度超过一定数值时（20-30 nm），在量子点的正上方产生了层错或者微孪晶等面缺陷，并且这些面缺陷随着覆盖层厚度的增加扩展到样品表面（图1所示）。这一发现对应变Si层的器件应用无疑是值得关注的结果。另外，对于两个靠近的量子点，这种面缺陷在两个量子点的内侧上方优先产生。根据低温生长Si覆盖层中应变能随厚度的变化及其释放定性地解释了这些现象。

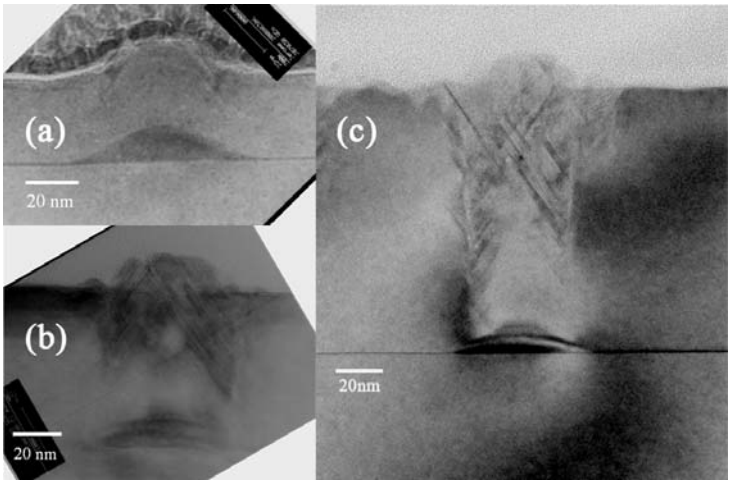

图1 样品的TEM图像。在300 ℃下，量子点分别覆盖了(a) 30, (b) 60 和 (c) 110 nm的Si层。

Experimental study of the exciton and surface plasmon coupling in the gold nanowires

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Surface plasmons can be employed to enhance not only the light emission rate in light emitting diodes but also the light absorption efficiency in photovoltaic devices. It can be expected that with proper design, metallic nanostructures can serve the dual functions as electrodes and efficiency enhancements for photovoltaic cells. Here we investigate the coupling between the excitons of conjugated polymers and the surface plasmons of the metallic nanowires. One-dimensional periodic Au nanowires with different width and periodicity are fabricated on glass substrates by electron beam lithography, and a 200nm thin layer of MDMO-PPV is spin-coated on top of these metallic nanowires. We will show our preliminary experimental results on optical spectroscopic measurements in this system.

肖诗逸

Abstract

We show a metallic plate with fractal-shaped slits supports TE surface plasmon polaritons as well as TM surface plasmon polaritons, with which we fulfill a subwavelength nearfield imaging at working frequency. On the basic of this, we find the mechanism of subwavelength nearfield image.

Aggregation Mechanism of GPA peptides studied by Molecular dynamics simulations

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Abstract

Amyloid fibrils associated with diseases such as Alzheimer's are often derived from the transmembrane helices of membrane proteins. In order to uncover novel sequence motifs mediating these interactions, we use a model peptide corresponding to a portion of the single transmembrane helix of glycophorin A. In this work, we have studied the equilibrium structures of the 17-residue fragment 70--86 in solution by molecular dynamics simulations. We show that the GxxxG motif and phe in glycophorin A(GPA) play important roles in folding amloid fribrils. To test this, we also select an inhibitor with GPA to study the aggregation mechanism.

Development of a variable-temperature MOKE system

Fangze Liu

Abstract

A variable-temperature MOKE system has been developed. The sample temperature can be accurately controlled between 130K and 500K. We can study the exchange bias phenomenon, the magnetic properties of ferromagnetic and antiferromagnetic films and multiferrotic materials around their phase transition temperatures via this system. According to the measurement of Fe/NiO, Co/FeMn and Fe/$BaTiO_3$, we conclude that the variable-temperature MOKE system has been set up successfully.

关于细胞的不同生长周期对荧光量子点的吞噬能力的研究

郑神

本研究旨在探寻处于不同分裂时相的细胞对量子点吞噬能力的差异，并寻找最易于吞噬量子点的时相。实验中使用了不同的药物、培养时间和条件等来控制细胞周期，用流式细胞仪检测细胞内量子点的荧光强度以及处于不同时相细胞的百分比，最后可使用线性方程组求得不同时相细胞对量子点吞噬能力的平均值。

Tunable Polariton Laser in ZnO Whispering Gallery Microcavity

孙聊新

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abstract

Polariton laser in the strong coupling regime is demonstrated in single ZnO tapered whispering gallery (WG) microcavity at room temperature. By scanning the excitation along the tapered arm of ZnO tetrapod, the threshold of polariton laser as a function of the detuning between the cavity mode and exciton is well investigated. It shows that the minimum threshold of the polariton laser appeared at a positive detuning of 42 meV, and a corresponding effect of blueshift versus pump power is also carefully addressed.

陈飞

Abstract

The discovery of iron-based superconductor has triggered another gold rush in material science. Although this type of material has high tolerance on chemical doping or structural distortion, detailed research has revealed that the electronic structure is very sensitive to the crystal quality. The synthesis of decent single crystal is the bottle neck to a deeper understanding of this very material.

My research includes synthesizing and characterizing of this very material. We managed to obtain single crystals of BaFe2As2 122 system with the self-flux method and FeTe(Se) 11 system with the NaCl/KCl flux method. The high quality has been confirmed with the assistance of Energy Dispersive X-Ray (EDX), Laue Diffraction, Low Energy Electron Diffraction (LEED) and also transport property measurement. Moreover with the state of art Angular Resolved Photoemission Spectroscopy (ARPES) technique, we have obtained the band structures of these compounds. And we try to reveal the evolution of the band, the formation of the Spin Density Wave (SDW), the relation between the SDW and superconductivity.

Exciton Polariton Waveguide in ZnO Nanorod

凌艳菁

Abstract

The design of optical waveguide has been studied extensively and used in various of applications. However, the wave guide for exciton polaritons has not been reported so far.

Here, we report an experimental demonstration of exciton polariton guiding phenomena in tetrapod ZnO. A comprehensive picture of the spectra evolution as the exciton polariton propagate along the arm of ZnO nanostructure was presented. By performing spectral measurements with the signal detection at the center of tetrapod and the excitation spot scanning along the arm, we observed a clear spectral shift and a dramatically reduced intensity at the high energy end of the spectra. A polariton waveguiding model was proposed to explain these interesting phenomenons.

Magnetic-resonance enhanced second harmonic generations in metamaterials

汤世伟

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Abstract

We have obtained spectra of second-harmonic generation from a fishnet metamaterial around its magnetic resonance. The resonant behaviors are distinctly different from those for ordinary materials. They result from the fact that the resonance is plasmonic, and its enhancement appears through the local field in the nanostructure. Then we have obtained by numerical calculations on second harmonic generations in some optical metamaterials, which are in excellent agreement with the experiments.

Field Effect Transistor of Graphene Junctions: Monolayer-Bilayer-Monolayer

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(Dated: April 26, 2009)

李炜

Abstract

We investigate theoretically electron transport properties through the field effect transistor (FET) junctions of graphene monolayer-bilayer-monolayer structure, which could be controled by the external applied gate voltage between up- and down-layer of bilayer region. By using the tight-binding approximation and Landauer-B¨uttiker formalism combined with the nonequilibrium Green function

approach, the conductance and current-voltage (I-V) curve have been studied within small bias voltages in the longitudinal direction. Our numerical results show that the I-V curve of the device shows an interesting negative differential resistance (NDR) features at a certain external applied gate voltage. This new physics finding is helpful for us to gain more insights about carrier transport in graphene FET junctions and to design graphene-based nanoelectronic devices.

Local field enhancement on the basis of SPPs phenomena

Z. An, C. Qu
屈澈

Abstract

We try to realize local field enhancement on the basis of effective SPPs phenomena. Metallic surface structure is used. When an TEM incident wave arrives at the surface, the local resonance will occur. As a result, in near-field scale, it provides quite high-amplitude electric field vector which is perpendicular to the horizontal plane.

Thickness-Dependent Oscillatory Magnetic Anisotropy in Single-Crystalline Fe Films

栗佳

The electrons in the ultrathin films with nanometer scale could be confined to form quantum well states (QWS), which could result in novel oscillatory behaviors of physical properties as a function of film thickness. For example, like the oscillation of the interlayer exchange coupling. In this poster, we report our study of the step-induced in-plane magnetic anisotropy of Fe thin film grown on Ag(1,1,10) vicinal surface by Magneto-Optic Kerr Effect (MOKE). The strength and the easy axis direction of the uniaxial magnetic anisotropy exhibits a novel thickness-dependent oscillatory behavior with a periodicity of 5.7 monolayers with the temperature below 200K. Such anisotropy oscillation is attributed to the QWS of the d-electrons at the Fermi level of the Fe film, which is different from most of the other oscillatory properties due to the QWS in non-magnetic layers.

Superconductivity and other instabilities in the two-dimensional extended Hubbard model

陈慧敏
Hui-Min Chen and Chang-Qin Wu

We investigate the competition between *d*-wave superconductivity (dSC) and antiferromagnetism (AF) in the extended Hubbard model on a two-dimensional square lattice by using the variational cluster approach (VCA). This method allows us to study the offsite interaction effect on the ground state and the excitation energies of system. We find the superconductivity favors offsite repulsion compared with attraction. On the other hand we study the possibility of another instability, so called ‘‘Pomeranchuk instability’’, characterized by the Fermi surface deformation which breaks the the point-group symmetry of the lattice structure.

Design of cloaks with both thermal and electric cloaking

李菁一

Based on the transformation method, we provide a design to implement a bi-function cloak with both thermal and electric cloaking. In this design, we propose a homogenized composite medium, in which metal particles are embedded in the adiabatic and insulating material, to realize the acquired values of thermal and electric conductivities. To analyse the details of the artificial structure and property of the cloak, the anisotropic effective medium theory (AEMT) is used as a generally practical method to control the shape and volume fraction of the metal particles in our composed material and COMSOL simulation will provide a support to the proposed cloak.

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J. Y. Li and J. P. Huang

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The internal tunneling effect in an entangled cold atom condensate

王金龙
导师：施郁

研究的体系是一种具有纠缠序参量的冷原子凝聚体，有两种原子 a 和 b，每种原子各有两种精细结构。原子之间的相互作用参数在特殊的情况下，体系可以变成类似经典的两个角动量之间的相互作用。这种情况下体系的基态是简并的。如果两种原子的数目相同，则基态是唯一的。在同种原子之间没有发生隧穿时，体系的总角动量是守恒的，各个角动量（赝角动量）的分量不随时间发生变化。

本工作主要研究在发生同种原子两分量之间遂穿的情况下，体系的各个物理量随时间的变化情况。在有遂穿的情况下，若体系在 0 时刻 z 分量的角动量不为 0 的话，则 x 和 y 方向的角动量随时间有类似经典角动量的演化过程。

The optical properties of surface-microstructured metal film

张赛锋

Saifeng Zhang, Li Zhao, Physics Department of Fudan University, Shanghai

Abstract: The light absorption, from 0.3 to 16.7 micrometer, of the surface-microstructured silicon and the coated metal film has been investigated. It shows significantly enhanced light absorption over such a wide wavelength range. In order to get the properties of pure surface-microstructured metal film, we develop a method to replicate the microstructure from silicon surface to PDMS. Then we can deposit a metal film (Au, Ag, etc.) on it. The optical properties of PDMS and the coated metal film have been investigated. The results can partly reflect the light absorption of pure metal film in the visible range. It opens up possibilities for potential applications in optoelectronic and detector fields, such as infrared detectors, stealth technology, silicon solar cells, and so on.

Magnetic control of light–matter coupling for a single InAs quantum dot embedded in a microcavity

任祺君

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We report the design, fabrication and optical investigation of the magnetically tunable singlequantum dot – micropillar cavity system. Unlike other studies where cavity-quantum dot spectralresonance was achieved by temperature tuning, we demonstrate that Zeeman effect of excitonsconfined in a single quantum dot is an efficient method to tune the quantum dot-cavity couplingsimply by varying the magnetic field. The tuning range of single quantum dot exciton transitions
can be as large as ~0.7 meV, which is much larger than the cavity mode linewidth (~0.3 meV).This enables us to tune the quantum dot emission into resonance with the fundamental cavity mode easily. An enhancement of the quantum dot emission due to the Purcell effect was also observed. Our results provide an alternative for realizing cavity-quantum dot based single photon devices.

Temperature Control the Ptoton-Exciton Coupling for a Quantum Dot Embedded in Pillar Microcavity

鹿建

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Semiconductor microcavity that provide non-classical light states, offer unique means of controlling light-matter interactions in confined geometries and have a broad range of applications in quantum information science including single-photon sources, quantum computation and quantum communication. In recent years, cavity quantum electrodynamics (QED) effects have been studied in varieties of solid-state systems. Here, we present a direct approach for the fabrication of self-assembled Ⅲ-Ⅴ quantum dots embedded in a pillar microcavity utilizing focused ion beam (FIB) etching. By tuning the temperature to control the coupling of the quantum dots with a discrete cavity mode, we observe a considerable Purcell enhancement effect and the temperature dependent behavior of single quantum dot is also studied.

Exciton activity in organic PV cell based on phosphor doped materials using endothemic energy transfer

陆旻

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Phosphor dye tris(2-phenylpyridine) iridium(III)($Ir(ppy)_3$) doped to Hole transport donor N,N'-Bis(3-methylphenyl)-N,N'-bis(phenyl)benzidine(TPD) has been investigated using transient absorption measurement of thin film and power conversion efficiency measurement of OPVC device. We presume that based on the mechanism of endothemic energy transfer this doped system can convert PL singlet exciton in host materials to triplet exciton conveniently. Then the triplet exciton with long diffusion length can easily arrive to interface and consequently increase the probability of exciton dissociation. Using transient absorption measurement we found that triplet exciton in this doped thin film with low doped concentration have long excited state lifetime. We also study OPVC device with the construct $Ir(ppy)_3$:TPD/C60/Alq/Al. This device has higher power conversion efficiency with thicker absorption host layer than the traditional OPVC device with CuPc.

Condensation of exciton-polaritons at room temperature

谢微

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abstract

We report one dimensional exciton-polariton dispersion in ZnO whispering gallery-like micro-rod at room temperature through angle resolved fluorescence spectrometry. The experiment results agree well with the theoretical calculation based on coupled oscillators model. By increasing pump power, we observe the condensation of polariton at the ground state of k-space at the threshold. Moreover, when pump power further increases, the adjacent WG polariton mode with lower energy is remarkably populated by polariton-polariton scattering process.

Electronic structure and band analysis of Transition-Metal Dichalcogenide: 2H-TaSe2

贺诚

Abstract
Mechanism of Charge Density Wave (CDW) transition in Low-Dimension materials still keeps in mystery since it was firstly discovered in last century. Thousands of papers have been published to try to uncover it, which keeps this issue still popular up to now.
We here show some ARPES result of the Two-dimensional material 2H-Tase2. From the Fermi surface mapping below and above transition temperature (T_C), the reconstruction can be clearly seen, which implies to forming a CDW state. Detailed band-cut temperature dependence has been operated, that locates in some high symmetry position in first Brillouin zone, from which we can clearly see the band gap has been opened, and the energy to the system is lower than normal phase. We still do the auto correlation analysis to make sure its CDW vector. All above data seems to support the mechanism of Fermi surface nesting mechanism. But in a EDC comparison we found some unusual behavior which could not well explained by latest theoretical results, that implies a new model dominating in this material.
C. He
072019021

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Induced β-barrel Formation of the Alzheimer's Aβ25-35 Oligomers on Carbon Nanotube Surfaces

付召明

Abstract：

Carbon nanotubes have shown potential applications that range from nanodevices, gene therapy, and drug delivery to templates for biomolecule assembly. Recent experimental studies show that carbon nanotubes also impact the aggregation process of proteins associated with neurodegenerative diseases. However, the details of molecular interactions between proteins and carbon nanotubes are still not well understood. In this study, we investigate the initial adsorption features and dynamics of the Alzheimer's amyloid-β peptide spanning residues 25-35 (Aβ25-35) on a single-walled carbon nanotube (SWNT) surface using fully atomic molecular dynamics simulations (MD) in explicit solvent. The initial configurations of the Aβ25-35 peptides consist of two pre-formed bi-layer β-sheets, each with four- or five β-strands in parallel or mixed parallel-antiparallel orientations. Our simulations for the first time show that two disjointed Aβ25-35 β-sheets with mixed parallel-antiparallel strands can assemble into β-barrels wrapping the SWNT. In contrast, both simulations of Aβ25-35 without SWNT, and simulations of SWNT–Aβ25-35 with purely parallel β-strands, lead to disordered aggregates. We find that Aβ25-35 β-barrel formation involves at least two steps: (i) curving of the Aβ25-35 β-sheets as a result of strong hydrophobic interactions with carbon nanotube concomitantly with dehydration of the SWNT-peptide interface, (ii) inter-sheet backbone hydrogen bond formation with fluctuating intra-sheet hydrogen bonds. Detailed analysis of the conversion reveals that β-barrel formation on SWNT surface results from the interplay of dehydration and peptide-SWNT/peptide-peptide interactions.